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Urban environmental quality and wellbeing in the context of incomplete urbanization in Brazil: integrating directly experienced ecosystem services into planning

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Abstract

The benefits of urban greenspace to residents are increasingly recognized as important to planning for sustainable and healthy cities. However, the way that people interact with and benefit from urban greenspace is context dependent and conditioned by a range of social and material factors. This paper applies and expands the ecosystems services based approach to understanding urban environmental quality and the way in which greenspace is appropriated by residents in the context of incomplete urbanization in three peri-urban target areas in Brazil. We develop and employ the notion of indirect (scientifically detected) and directly experienced ecosystems services, and undertake a science based ecosystem services assessment and a qualitative analysis of interviews, walking narratives and images captured with a smartphone application to understand what functions urban greenspace serves in the daily life of the studied neighborhoods. Findings demonstrate how elements of urban greenspace and what can be termed ecosystem services serve both material and signifying functions and produce subjective and collective benefits and dis-benefits that hinge on aspects of livability such as quality of urban service delivery, housing status and perceptions of crime and neighborhood character. We identify factors that enable, hinder and motivate both active material and interpretative interactions with urban greenspace. The findings suggest that the relationship between ecosystem service provision and wellbeing is better understood as reciprocal rather than one way. Although at the neighborhood scale, fear of crime and poor access to urban services can hinder positive engagements with urban greenspace and experienced benefits from ES, urban squares and fringe vegetation is also being appropriated to address experienced disadvantages. Presently however these local interactions and ecosystem service benefits are overlooked in formal planning and conservation efforts and are increasingly compromised by growing population density and environmental degradation. We make recommendations for a nuanced assessment of the material and interpretative human-nature interactions and associated ecosystem services in an urban context, and discuss the potential for planning initiatives that could be employed to articulate and nurture these important interactions in our target areas.

Keywords: Incomplete urbanization; wellbeing; ecosystem services; right to the city

1. Introduction

It is now broadly acknowledged that urban greenspace can significantly contribute to the wellbeing of city dwellers (Ravez 2015; WHO 2016) and some have suggested that access to good quality public greenspace is particularly beneficial for disadvantaged communities (e.g. Mitchell et al. 2015). But visiting urban parks and water bodies is not just conditional on physical access but mediated by a complex range of factors meaning that 'available' benefits may not be experienced by all (Wolch et al. 2014). In this paper, we examine how the benefits of urban greenspace are conditioned by a range of social and physical factors in a disadvantaged urban periphery in Brazil. In areas where urban inequalities are chronic and structural – such as the context of incomplete urbanisation in Brazilian cities – lack of urban infrastructure and services often converges with poor environmental quality (Costa and Costa 2005). Incomplete urbanisation, referring to the lack of urban infrastructure and services not only in areas of informal 'favela' settlements but also in areas of lower and middle income housing has complex drivers (Fernandes 2007; Costa and Costa 2005). It is seen as a means of providing affordable housing to the very poor but also as a deliberate omission of infrastructure investment on the part of local authorities who do not want to invest in areas of low returns. The spread of informal housing and processes of incomplete urbanisation have created often quite evident spatial hierarchies between and within settlements, and our proposition in this paper is that the way urban greenspace is not just distributed but also engaged with and experienced differs along this hierarchy as do its positive contributions to wellbeing and liveability. We employ the ecosystem services (ES) framework to examine how urban greenspace is engaged with to yield benefits and dis-benefits (e.g. Lyytimäki et al. 2008) in the context of incomplete urbanization and the gradual formalisation of land and dwellings that has been either informally appropriated or donated to displaced communities in three peri-urban areas in the municipality of Contagem, Brazil. Our analysis provides an insight into the politics of urban ES and we provide recommendations for ES based urban planning efforts that align with a broad interpretation of the right to the city (Lefebvre 1996; 2001).

While material inequalities such as those associated with income and access to infrastructure and technology impact people's ability to benefit from ES (Anderson et al. 2015), literature increasingly also acknowledges the role of 'culture' in our engagements with nature and the interpretation of these as services, goods and benefits (Dias et al. 2018; Fish et al. 2016). The role of cultural interpretations and practices in modulating interactions with nature sits less easily within the Millennium Ecosystem Assessment (MEA 2005) categorisation of ES, and like the IPBES community (Dias et al. 2018), we suggest that the conventional categorisation of ES into four groups affords only limited access to the multiple relations of agency that humans foster with nature (Latour 2004; Murdoch 1998). For example, urban greenspace is engaged in highly politicised processes of 'green gentrification' and other more subtle ways of differentiation (Wolch et al. 2014). Moreover, ES research is beginning to identify contextual and subjective factors, such as social cohesion and self-identity, that affect how urban nature is engaged with and interpreted (Fischer and Eastwood, 2016; Fish et al., 2016; Juntti and Lundy 2017). Juntti and Lundy (2017) suggest that we need to recognise how particular urban ES and the biophysical features that these are derived from therefore serve a broad range of highly context dependent material and signifying functions as a part of urban everyday life (e.g. DeLanda 2016). In order to embrace the complex and hybrid socio-material interactions that constitute everyday life in an urban context, we employ a framing of ES that distinguishes between ES that are directly experienced by people, and ES that are made present

through scientific detection and therefore termed 'indirect'. Viewing ES that are directly experienced as based on a hybrid relational ontology of co-production and co-construction (Latour 2004; Murdoch 1998; Barnaud and Antona 2014; Fischer and Eastwood 2016) provides analytical access to the variations that are likely to occur in how directly experienced services and benefits or possibly dis-benefits are accrued and mediated by both subjective and contextual factors including the formal planning context and the politics of urbanisation.

We persist with the ES based approach to understanding urban environmental quality because we believe that there is value in the interdisciplinary scope that it affords. This paper integrates findings from a science led scalar assessment and quantification of services provided by ecosystems and their potential benefits at the metropolitan and local scales in the Belo Horizonte metropolitan area, as well as in-depth interviews and a walking methodology employing a smart phone app (the UrbanApp, Juntti et al. 2015) aiming to understand how people at neighbourhood level engage with urban nature as a part of their daily lives. Our empirical research focuses on three closely linked target areas in the catchment of the Vargem das Flores reservoir in Minas Gerais, Brazil. The qualitative analysis focuses on the situated processes of engagement through which people create and assign meaning to the features of their environment with a specific focus on the scientifically identified ES providing units such as green urban squares, street trees and urban fringe vegetation. This interdisciplinary analysis enables us to arrive at a contextualized understanding of indirect and directly experienced ES and associated benefits and dis-benefits and to consider these in the specific socio-economic context of our target areas. All three target areas have formal and informal housing and are situated in the catchment of the Vargem das Flores reservoir that serves as a significant source for metropolitan water provision. The paper responds to the following research questions:

- What role does urban greenspace play in the everyday life of residents of such disadvantaged peri-urban neighbourhoods?
- How do subjective, material and social factors such as gender, availability and quality of greenspace, urban service delivery, housing status and livability variables such as perceptions of crime and neighborhood character mediate the functions of and benefits from greenspace?
- What kind of scientifically detected ES are there in the target areas, to what extent do these reflect the experienced ES among local residents and what implications does this have for urban environmental justice and the use of ES based approaches in urban planning?

The paper is structured as follows: first, we develop the constructivist approach to urban ES. We suggest, that in order to really understand 'access to ES' in urban environments, we need to study experienced ES in the context of spatial practices and representations that constitute the everyday life of the city. We acknowledge that the interactions through which ES are co-produced and co-constructed are contingent on the broader urban context, in our target areas characterised by the notion of incomplete urbanisation (Costa and Costa 2005). In the methodology section we introduce our target areas, the peri-urban settlements of Nova Contagem, Tupã and Solar do Madeira in the municipality of Contagem, state of Minas Gerais, Brazil. We provide a formal representation of ES in the area, based on a science led ES assessment, in order to understand the sustainability assets and challenges that the catchment area is faced with. The Vargem das Flores reservoir serves a significant water provisioning function at the Metropolitan scale, and there is an ongoing

Metropolitan Plan-making process that has brought to a head a scalar conflict between municipal and metropolitan authorities concerning the environmental zoning aiming to protect water quality in the reservoir. In section four we examine the directly experienced, lived and interpreted ES in the target area making reference to the service providing units (SPUs) produced by the ES assessment. We explore how in our target areas, ES are appropriated by residents to mark an informal hierarchy of settlements and to subvert undesired activities such as anti-social behavior and crime. Although the formal planning conflict is not acknowledged in our interviews, its impact is felt in the form of the absence of municipal intervention and speculative land purchases in the target areas. Though the interviews portray a lack of agency among residents who have little influence over the quality of municipal services, high crime rates and low mobility, it is evident that urban greenspace and the reservoir are engaged with in a range of ways that contribute to wellbeing and quality of life. We outline contextual factors that support, hinder and motivate engagements with urban greenspace and underpin the provision of experienced ES. Presently, experienced ES do not always align with the scientifically identified ES potential, particularly the ES that are central to the reservoir's water provisioning function, but there is potential for reconciling local and metropolitan scale ES based benefits through progressive planning approaches in the target areas. There is a long tradition of social movements and their vicinity to formal planning institutions in Brazil, which is also manifest in our target areas (Monte Mor et al. 2016). In section five, we comment on the kind of analytical and empirical methods and planning approaches that can be used to integrate a more contextualised and contingent understanding directly experienced ES and their role in urban liveability and wellbeing into policy and planning. Finally, we draw conclusions on the ability of the relational ontology and the notion of experienced ES to expand the scope of ES based approaches to embrace the significance of urban greenspace in residents daily lives and the role of the broader urban context – including the politics of urbanisation - in mediating this. We recommend objectives for policy and further research.

2. Ecosystem services, wellbeing and urban liveability

2.1 The ecosystems services approach as an integrated and dynamic representation of environmental quality in urban areas

The idea of ES was first introduced to global policy in the UN Convention on Biological Diversity (CBD 2000) aimed at the protection of species and habitats. The CBD advocates an ecosystems approach, from which 12 management principles are derived. These attempt to respond to the fault lines identified in the conventional efforts of biodiversity conservation, based mainly on a focus on species rarity and scientific value. The notion of ES integrates many of these principles by embracing the dynamic nature of environmental change and the significance of ecological processes to human social and economic ones. The Millennium Ecosystem Assessment (MEA 2005) establishes linkages between aspects of human wellbeing and the ecological processes termed ES (Figure 1) – many of which of course extend beyond biodiversity, and underpin the survival of life on the planet. In perceiving wellbeing as consisting of security, basic material for good life, health, good social relations and freedom of choice and action, the MEA approach reflects a large literature on the subject. In environmental justice literature wellbeing is used to refer to the ability of individuals to fulfil their needs and to lead the kind of lives in which they find meaning (e.g. Edwards et al. 2016; NEF 2012). Wellbeing is therefore recognised as being socially constructed and subjective, but nevertheless hinging on the basic components of human agency, many of which are supported by engagements with ES.

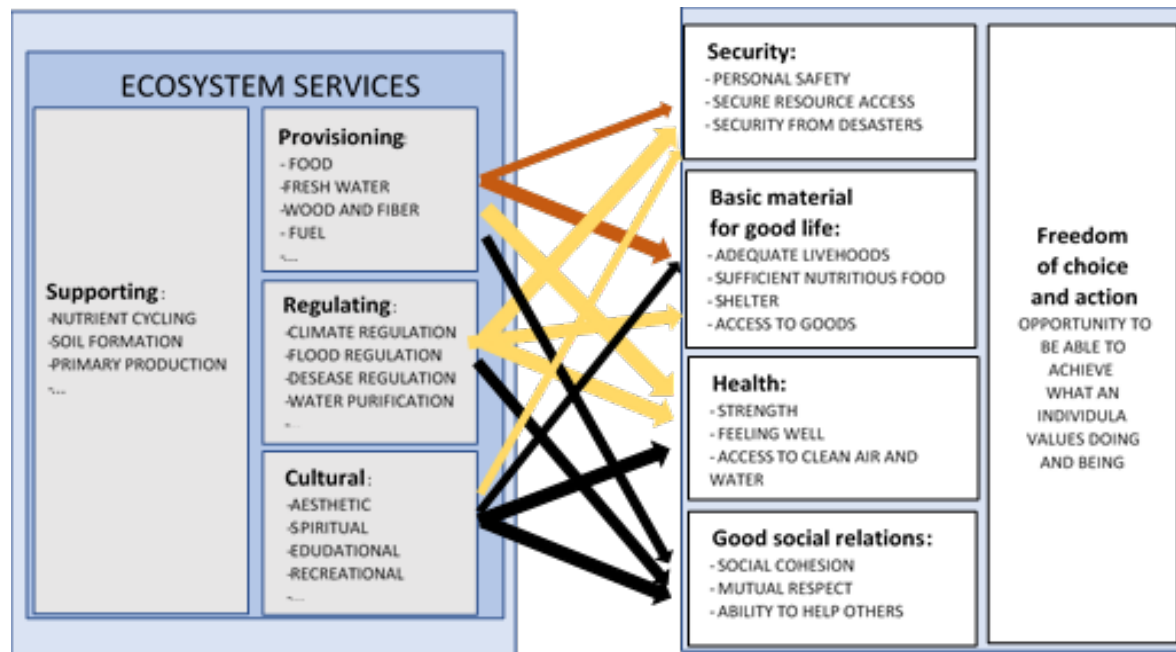


Figure 1: the MEA classification of ecosystem services and links to the constituents of wellbeing (MEA 2005: 78)

Urban ES have for long been approached via a conventional scientific epistemology exemplified by the ES cascade model, where an ecosystem's physiological characteristics and the employed land-uses drawing on these, form ecosystem Service Providing Units (SPU) (Spangenberg et al 2014). According to the latest applications of the cascade model, potential ES based on the use value appropriation of SPUs are mobilised (or not as it may be) into actual ES which are then appropriated into benefits or possibly dis-benefits or ecosystem dis-services (EDS) (Spangenberg et al 2014; Lyytimäki et al. 2008). But very little is known about the factors that condition the translations from SPUs onwards to actually experienced direct ES or EDS (Figure 2). This underpins the widespread impression that as long as urban greenspace is present, benefits from it will automatically flow to residents. However, Anderson et al. (2015) suggest that a range of contextual factors that can be grouped as social-technical (e.g. user rights and infrastructure needed for access), environmental issue related (e.g. local flood risk and air pollution levels) and cultural (religious values and subjective preference) condition to what extent benefits are actually accrued. In other words, the air purification service of urban greenspace is only valuable in the presence of air pollution and a quiet urban greenspace may be of high value to some but perceived as dangerous by others (ibidem). Earlier research in an urban context found that different dimensions of 'liveability' (e.g. van Dorst 2012), such as perceptions of crime, the nature and extent of social interactions and the extent of spatial differentiation and inequality play a role in how ES are experienced (Juntti and Lundy 2017). For example views of and vicinity to urban water features was seen as prestigious in an inner London neighbourhood, and influenced the perceived hierarchy of housing on the estate in question causing new rifts among social housing residents. Fish et al. (2016) suggest that cultural practices both shape and enable the production of ES. In this paper, we argue therefore that the link between ES and aspects of wellbeing (Figure 1.) is complex, contingent and in fact, reciprocal. The wellbeing of urban residents not only hinges on what ES they directly or indirectly interact with but that aspects of

wellbeing (feelings of security, ability to influence one's surroundings and make meaningful choices) also influence how they experience and engage with urban greenspace.

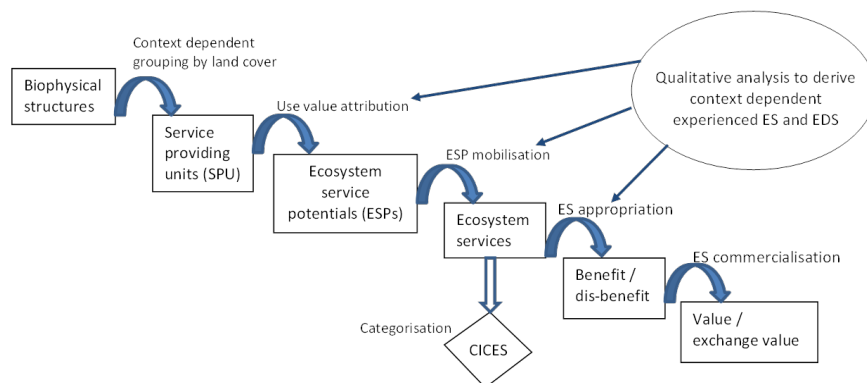


Figure 2: the ES cascade model and the integration of data on experienced (co-produced and co-constructed) ES and EDS (Juntti and Lundy 2017 modified from Spangenberg et al. 2014)

In order to investigate the contingency of the experienced benefits and dis-benefits derived from urban greenspace, we adopt a relational ontology whereby ES are viewed as co-produced (in collaboration with humans and non-human networked entities) and co-constructed, individually and collectively, as imbued with meaning and signifying different things depending on the individual in question and the social and political context (Murdoch 1998; 2001; Barnaud and Antona 2014; Fischer and Eastwood 2016; Fish et al. 2016; DeLanda 2016). This distinguishes between active engagements that co-produce ES and are crucial to many of the health benefits of urban nature for example, and signifying functions that are passively assigned for ES and SPUs. It is these signifying functions that play a role in the urban everyday life, organizing and demarcating space and spatial practices and among other factors, influencing active engagements with SPUs. There is for example a wealth of literature on urban cultural ES that suggest that urban green space can contribute to place-making as well as individually derived benefits such as lowered cortisol levels (La Rosa et al 2015). But this is not the case for all people to an equal extent, as demonstrated by the literature on environmental injustices associated with access to and the quality of urban green space (Wolch et al. 2014). Also feminist and queer approaches highlight how framings of positive or desirable features of public spaces such as parks or campsites often accommodate 'mainstream' behaviours but deter others, and can therefore be experienced as alienating by many (Wolch et al. 2014; Mortimer-Sandilands 2005). Green gentrification in turn provides an example of collective value assignation that is also highly context dependent as it requires the existence of mediating factors such as property pricing and marketing mechanisms, and does not benefit all to the same extent. In fact, elements of green gentrification such as rising property prices disadvantage many and can be interpreted as an EDS.

Figure 3 portrays the different ontologies of the predominantly science-based ES cascade theory (Spangenberg et al. 2014) and directly experienced ES and EDS. The relational ontology provides analytical access to the subjective and socio-cultural factors such as cultural values, identity and capability that influence how potential ES are mobilised into experienced ES and EDS and may also contribute to the co-production of SPUs (Figures 2 and 3; Fischer and Eastwood 2016; Fish et al. 2016). Previous research demonstrates that scientific and lay reports of environmental values and

benefits vary in terms of breath and interpretation (Juntti and Lundy 2017; Dias et al. 2018). In order to maximise the benefits associated with urban greenspace, planning needs to take on board the different social and cultural variables, codes and interpretations that condition how green features are understood and experienced (Juntti and Lundy 2017).

To sum up, through the concept of experienced ES (and EDS), we aim to examine ES in the context of the mechanisms of interpretation and engagement through which people appropriate their local environments for the purposes of everyday life and wellbeing and through which the meaning of place is constructed and maintained (Massey 2004). The idea that environmental quality is experienced as a function of everyday life is well established in the literature on place based conservation (Williams et al, 2013; Pacione 2003). Working with the ES metaphor (e.g. Norgaard 2010) enables us to develop an interdisciplinary understanding of those environmental values and functions that science has conceptualised as ES and the experienced socio-material interactions that people engage in through their everyday lives in those environments. The constructivist relational ontology (e.g. Murdoch 2001; Fischer and Eastwood 2016; Juntti and Lundy 2017) of experienced ES is necessary for beginning to make sense of the significance and value of urban ES beyond existing efforts at economic valuation.

While the ES concept proposes yet another 'logic' for the ordering of urban space (Latour 2004), we suggest that there is a pressing need to expand the prevalent ES assessment and delivery approaches towards more embedded and epistemologically diverse practices in order to integrate considerations of urban social and environmental justice (see also Petersen et al. 2018 Figure 3). Our analysis teases out those lived and practiced appropriations of urban nature – or experienced ES and EDS – that shape the everyday lives of the residents of our peri-urban target areas in the catchment of the Vargem das Flores reservoir in Brazil. Our findings highlight experienced ES and EDS as valid representations of the urban context that should be considered in formal planning practices as relevant to the everyday lives of the local communities and therefore to environmental justice.

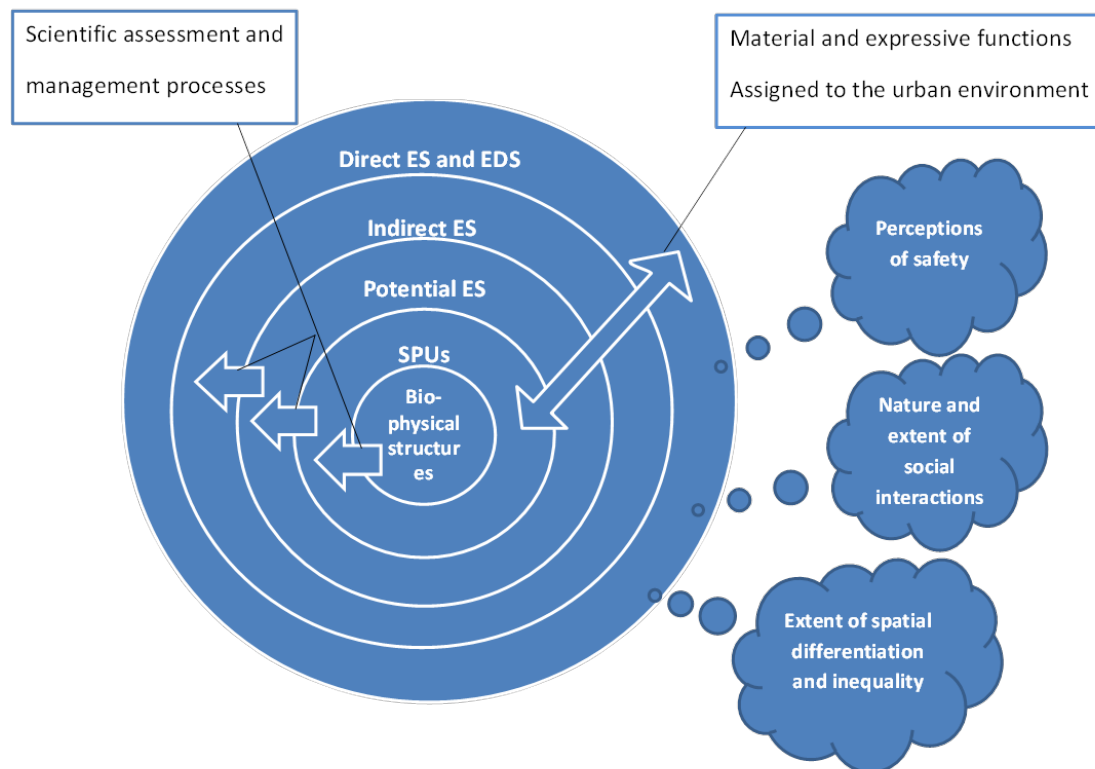


Figure 3. the difference between scientifically identified potential ES as per the cascade model, and directly experienced ES and EDS (Juntti and Lundy 2017)

2.2 Power, space and incomplete urbanisation in the Brazilian context

It is often suggested that Lefebvre's 'right to the city' (Lefebvre 2001) is institutionalised in the Brazilian urban planning system, for example at the federal level in the form of the 2001 City Statute that aims to guard the rights of the dispossessed classes (Fernandes 2007). According to Fernandes (2007), 'spontaneous' or informal settlements, constitute approximately 50% of urban housing in Brazil. This refers to housing where formal deeds do not exist or, if there is formal proof of property ownership, this is not registered with the local authority (Ferreira and Ávila 2018). The 2001 City Statute aims to ensure that measures are taken at regional state level to guarantee the rights of the occupants of these informal dwellings and that most are gradually formalised, issued deeds and integrated into urban infrastructure networks. Nevertheless, this high degree of informal housing has led to a situation not uncommon globally, where environmental and social disadvantages tend to intersect, particularly in peri-urban areas (Costa and Costa 2005). The notion of incomplete urbanization emerged in the works of the Brazilian geographer Milton Santos (2009; 2010[1982]) and adopted by several authors, refers to a process of urbanization typical of societies of the periphery of capitalism, where material items and/or social relations are lacking or missing altogether. In a broader economic sense, it refers to qualitative or quantitative transformations in urban space that reflect ongoing trends and developments in demographic, consumption and production processes (Santos, 2010). In terms of the production of urban space, incomplete urbanization refers to a process in which the social agents responsible for developing new areas, avoid or are not interested in investing in all items required by the urban legislation, as a means of keeping land and property prices low, so that more people/families can afford to buy plots or dwellings, and profits can still be made. The outcome is well known: areas without proper

infrastructure and services such as safe water supply, adequate sewage systems, garbage collection and disposal, frequent and reliable transportation, and paving. Incomplete urbanisation may also refer to lack of social and environmental and leisure infrastructure such as parks and gardens, street trees, adequate schools and health services, sports facilities, child care, care facilities for the elderly, and accessible grocery stores. It is important to point out that in Brazil, a significant proportion of such urban items are (or are seen as) state responsibility – municipal, regional or even federal – others are provided by concessionaries and by private companies, depending on the specific regulations governing them (Fernandes 2007). In many cases, due to lacking services, needs are met through community initiatives, such as groups of women organized to share child care and informal transportation networks, among a number of actions that emerge by means of solidarity or self-organization for sharing expenses. There is some evidence of these in our data, especially in the studied neighbourhood of Tupã, or in one case a single street in Nova Contagem, where collective action among neighbours has improved liveability. Though wellbeing and quality of life can be improved through community action, areas of incomplete urbanisation remain vulnerable to displacement and development pressures.

Incomplete urbanization is associated with three types of social housing development depending on the social agents that produce urban space:

Type 1 – formal popular housing estates – consists of state led initiatives with basic infrastructure but lacking many of the above urban services such as commerce and public greenspace. Housing has often been donated to residents due to displacement through poverty or natural disaster.

Type 2 – informal popular land developments – mediated by a range of private or public and private agents., This type constitutes the most common form of housing provision in peripheries. These localities are often missing several key urban services. Dwellings consist of self-built housing and have often received funding from particular financing mechanisms. This category of housing constitutes the majority of irregular housing in Brazil and does not discriminate in terms of socio-economic status: high-end development does not guarantee formal planning status.

Type 3 – spontaneous informal land occupations by individuals or groups within already developed or newly occupied areas. These slum or favela dwellings are mostly missing all urban services and items and are the principle housing solution for the poorest classes of the Brazilian society.

It is commonplace for authorities not to interfere in the development of informal settlement types. Municipal authorities are often happy to let people 'fend for themselves' in terms of acquiring housing informally, but subsequently neglect basic service provision on the pretext of the informal status of these inhabitations. 'Incomplete urbanisation' is therefore a by-product of the logic of capitalist accumulation - there is a documented tendency among civil authorities to avoid spending in areas which lack the assets for lucrative capitalist relations, creating a vicious cycle of underinvestment and deteriorating liveability (Costa and Costa 2005; Maricato 1979). Despite the 2001 City Statute, in most cases, particularly in the peripheries, regularisation of informal housing is rarely undertaken rigorously for many reasons: in part for lack of adequate personnel and resources, in part for lack of surveillance and formal mechanisms to complain or to ensure that legislation is enforced (Fernandes 2007). As far as housing and land developments are concerned, the formal attendance to the urban legislation requirements usually results in land and housing prices that are not affordable by the population that are most in need of them. Therefore, incomplete urbanization and urban and social informality are part of one and the same process. Until very recently, housing

was not allocated any state subsidies, and renting, either of private or social housing, did not constitute a reliable housing strategy.

3. Methodology, the target areas and their potential ecosystem services

3.1 The target areas and their planning context: disadvantaged peri-urban settlements

The target areas pictured on the map in Figure 4. are situated in the municipality of Contagem, the main industrial area of the Metropolitan Region of Belo Horizonte in the Minas Gerais state. Ferreira and Ávila (2018) suggest that the State of Minas Gerais has been particularly proactive in securing tenancy conditions, estimating the percentage of informal dwellings at just over 20% of all housing provision. The majority of the informal occupations are however concentrated in Belo Horizonte, the main metropolitan region within the state, within which our target areas fall. Belo Horizonte is formed by 34 municipalities and has approximately 5 million inhabitants, half of which live in the capital city of Belo Horizonte. One of these, the urban settlements of Contagem evolved from the industrial expansion of Belo Horizonte to the west - encompassing its historical centre - along the road that links Belo Horizonte to São Paulo and forms a significant economic corridor of industrial and service-based development. The Vargem das Flores reservoir catchment (Figure 4) extends over a large part of the Contagem municipal territory, constituting an important source of drinking water for the metropolitan region and forming the location for our target areas. The reservoir and the water supply system is operated by Copasa, the local water utility company, whose advocacy has played a key role in the designation of the reservoir and surrounding areas for environmental protection. Although these controls have significantly limited development, there nevertheless are a number of informal settlements surrounding the reservoir. These settlements span all income groups, a common occurrence in Brazil (Ferreira and Ávila 2018), but are predominantly occupied by those classed as low-income within these designated zones.

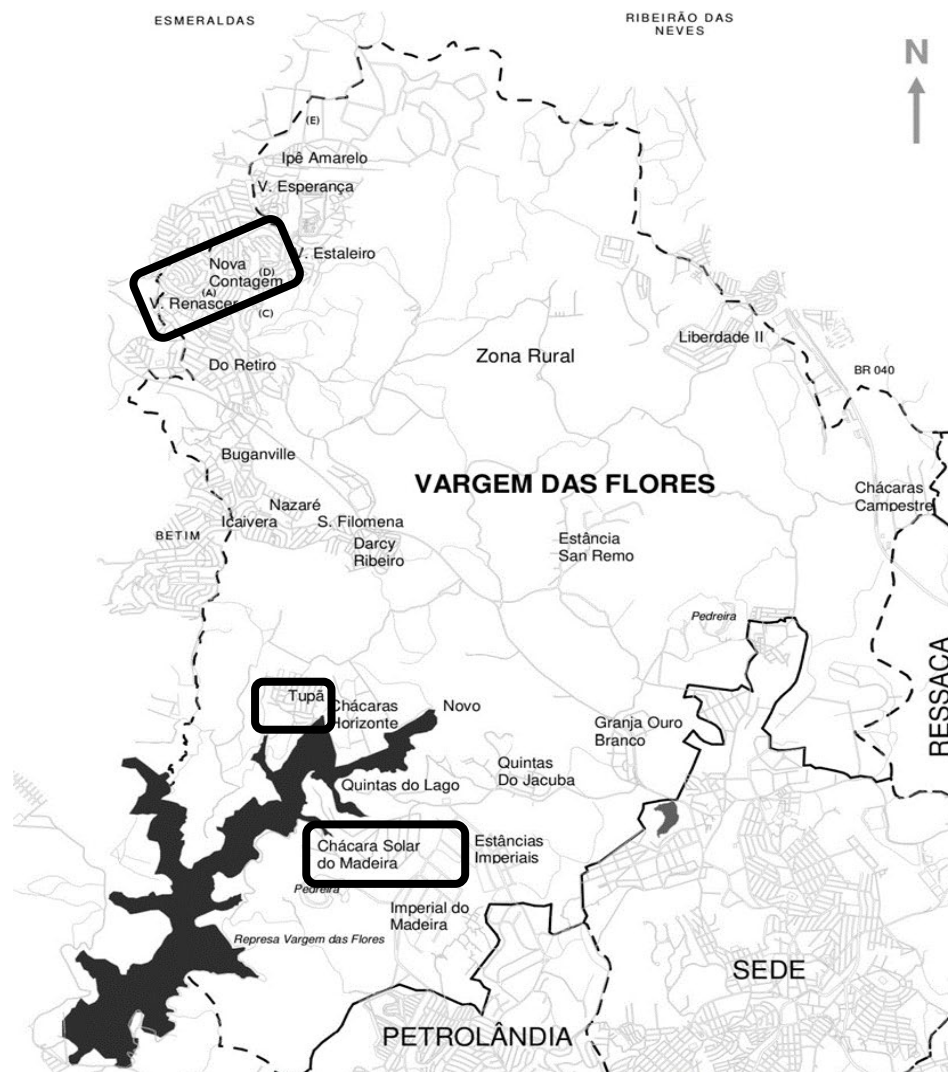


Figure 4. Map of the Vargem das Flores reservoir and administrative area within which our target areas of Nova Contagem, Tupã and Solar do Madeira are located. Source: adapted from Secretaria municipal de Desenvolvimento Urbano 2014

Our target areas consist of the settlements of Nova Contagem, Tupã, and Solar do Madeira (Figure 4). The centre of Nova Contagem is formed by a social housing estate (type 1 housing development) built in 1984 as the result of an electoral compromise by a former populist mayor who later became the governor of the state of Minas Gerais. The housing was intended for disadvantaged groups of people relocated from other regions in Contagem due to inadequate living conditions, lack of space and the need to clear more affluent parts of the municipality of informal housing, or simply due to having been priced out of the rental market (Brittes 2015). The new housing estate was located at the northern border of the Contagem municipal territory, forming a new urban frontier, to use Neil Smith's (1996) expression, around which newer housing developments were subsequently formed. In the early years of the estate there was shortage of transport, electricity and waste management provision as well as of shops for food provision and other needs but this has gradually improved. There are also type 2 land developments in Nova Contagem, and our other target areas, developed and financed by the private sector, where the developer provides the parceling of land, the road system, the subdivision of plots and the items of infrastructure required by law – water, sewage and drainage provision, as well as areas for public services and green space, among other legal

requirements. The newer settlements surrounding central Nova Contagem are typical to the type 2 development catering for low income households and tend to be located in less attractive areas, with often poor service and infrastructure provision, as developers invest less in order to make a profit and sometimes also to deliver an affordable product for the majority of the population, even if the product is a very poor one. This type of low income private development constitutes the main provision responding to low income families' housing needs in Brazil and is the prevalent model of housing development in peripheral areas. It is notable, that these houses are not a form of spontaneous settlements (type 3), but are the result of the action of a specific private social agent that specializes in developing low income (and low quality) areas, producing incomplete urbanization (Costa, 1983; Maricato, 1979). In addition to this type 2 settlement, the more peripheral areas of Nova Contagem (e.g. in Esmeraldas which pre-dates the 1984 development, Ipê Amarelo and Bougainville – see Figure 4) also contain spontaneous occupations (type 3) or 'invasions', a more derogatory term used by our interview respondents. While the urban centre of Nova Contagem is situated within the Vargem das Flores catchment, but relatively far from both the reservoir and the Contagem city centre, our second case study area, bairro Tupã borders the reservoir itself. Tupã, which pre-dates the reservoir, is a relatively sparsely occupied mixture of type 2 and 3 housing. The territory between Nova Contagem and Tupã is classed as rural. Our third target area, the nearby neighbourhood of Solar do Madeira represents high or medium income private development (type 2), usually in an attractive environment where natural features contribute to the price and marketability of housing plots. While most such settlements are gated (despite this being an illegal practice in Brazil), Solar do Madeira, also bordering the reservoir, is freely accessible and relatively low density. It is important to point out that in both high and low income privately financed (type 2) housing development, it is just the plot that is produced, without the actual house. Distinct from the public housing model, in this case the social agent responsible for producing urbanized land is different from the social agent responsible for producing the dwelling. The houses are built through whatever available and affordable means, usually by self-help or, in the case of the low income sector, family labour. The urbanistic and environmental outcome is an enormous amount of incompletely urbanized land, and a significant number of vacant plots, resulting in very low densities, making any upgrading of infrastructure and service provision very expensive. In terms of sustainable planning, it would be preferable to have higher densities and more rural or undeveloped land for other uses.

In Brazil, urban territorial planning, especially land use planning, is mainly the responsibility of local – i.e. municipal – administration. Although federal and state (Minas Gerais) level regulations have precedence, the local municipal level Master Plan is the most important instrument in defining the ways in which land can be developed, which areas are protected, which are classified as rural and which urban. The Federal Constitution (1988) and the City Statute (2001) establish the Municipal Master Plan as compulsory for municipalities with 20 000 inhabitants or more, and those municipalities located in metropolitan regions and zones impacted by large projects. Through this emphasis on the local level, the City Statute aims to provide the means for 'urban reform' at municipal level by assigning legal control over property capital investments and projects to the municipal authorities. This is intended to facilitate the 'democratic management of cities', which usually refers to participatory projects and initiatives, creation of local committees for urban, social and environmental policies, or participatory budgeting. However, the new Metropolis Statute, in force since 2015 stipulates a Metropolitan Master Plan with associated 'macro-zoning' according to

metropolitan scale planning concerns as compulsory to all metropolitan regions of the country. The State of Minas Gerais embarked on this process already in 2009, when previous state legislation proposed an institutional arrangement which included a metropolitan plan, a fund, an assembly, a development committee, and an agency to implement metropolitan planning. The process has involved macro-zoning and more recently, the revision of municipal masterplans that will be oriented by the metropolitan plan, which is presently under deliberation at the Minas Gerais State Assembly (see e.g. Monte-Mór et al. 2016).

In the Metropolitan Plan, the Vargem das Flores catchment is proposed as a Zone of Metropolitan Interest (ZIM). This designation, based on the significant water resources of the area and their role in meeting water needs at the metropolitan scale, stipulates careful consideration and containment of urban land uses, effectively prioritising metropolitan scale water needs over local planning and housing needs (Eleuterio et al. 2015). This is a contentious issue locally, and the present mayor of Contagem has challenged such a hierarchy of interests, suggesting that planning powers should be kept in local hands with the municipality as the controlling authority. In fact, in an attempt to justify better service provision and to establish better control over spontaneous occupations in the area, the new Municipal Government has proposed to bring more housing development to the Vargem das Flores catchment. This means that the Metropolitan Plan and the Municipal Plan are in direct conflict in regard to how the catchment should be managed. The Metropolitan Plan champions the Trama Verde e Azul (TVA) approach (Eleuterio et al, 2015) that aims at the identification, protection and valorisation of special cultural and ecological features such as waterbodies, protected habitats and landscapes, and mountains to achieve mutual benefits for conservation and local economies through green infrastructure solutions and tourism. While the dispute over authority between the planning scales appears to have come to a head, the matter is presently under deliberation in the Minas Gerais State Assembly and needs to be resolved in order for the either plan to be ratified. Nevertheless, a range of environmental legislation related to watershed and nature protection (the national network of protected areas SNUC, Brazil 2000) does already apply in the area and finally, the municipal plan in force stipulates obligations in several areas such as sanitation, waste collection and disposal, social housing provision, land regularization, mobility and transportation, to name the main issues. In short, there is quite a sophisticated regulatory apparatus at all government levels, including the municipal level, but there are significant scalar tensions and the enforcement of any protection or service provision obligations has so far remained ineffective in our target areas.

3.2 The scientific assessment of ecosystem services in the target areas

A matrix based ES assessment was carried out to understand the potential for the provision of all four classes of ES in our three target neighbourhoods, with particular focus on their role in the water provisioning function of the Vargem das Flores reservoir. The ecological landscape concept (Barbier, 2011), land use assessment through high resolution satellite images (see figure 5), field visits and photographic documentation were used as the basis for the identification of SPUs and potential for providing ecosystem services such as in the case of riparian areas and other urban freshwater habitats (National Academic Sciences, 2002; Lafond, Marsalek and Breil, 2008; Zalewski and Wakner, 2008; Lundy and Wade 2011); soil, catchments and wetlands (Daily, Matson and Vitusek, 1997; Pastel and Carpenter; 1997; Barbier, 2011) and urban green areas and forests (McPherson et al, 2005; Lundy and Wade 2011). Satellite images were then used to further interrogate the case study areas to identify and group biophysical structures according to their dominating features (Anderson

et al, 2015), such as scale, level of management, and presence of water. Figure 5 presents the findings of this analysis for the Nova Contagem target area. It is evident that central Nova Contagem is void of urban fringe vegetation and the size of private green areas, mainly back gardens, is smaller than in the surrounding neighbourhoods, and that the largest green areas are being provided by the riparian areas of urban streams. Site walkovers were undertaken, during which the presence of biophysical structure types was verified and subjectively translated into the SPUs displayed in Table 1. This translation activity was undertaken as a way to link biophysical structures with land use cover typologies. This approach allowed the identification of five SPUs in Nova Contagem area, as follows: 1. urban fringe native vegetation, 2. vegetation in squares, urban parks and streets, 3. streams, riparian areas, wetlands, 4. trees in private areas, urban agriculture, 5. bare soil (Figure 5 and Table 1). An estimation of their potential for providing ES at spatial (local, regional) and temporal (permanent, seasonal) scales (Table 1) was also undertaken. ES data from the literature (e.g. MEA, 2005, UK NEA 2011, Gomez-Baggethun et al., 2013, Lundy and Wade 2011), combined with field notes, were used to further support the identification of the potential ES and goods delivered by each urban SPU (Bradshaw and Linneker, 2017).

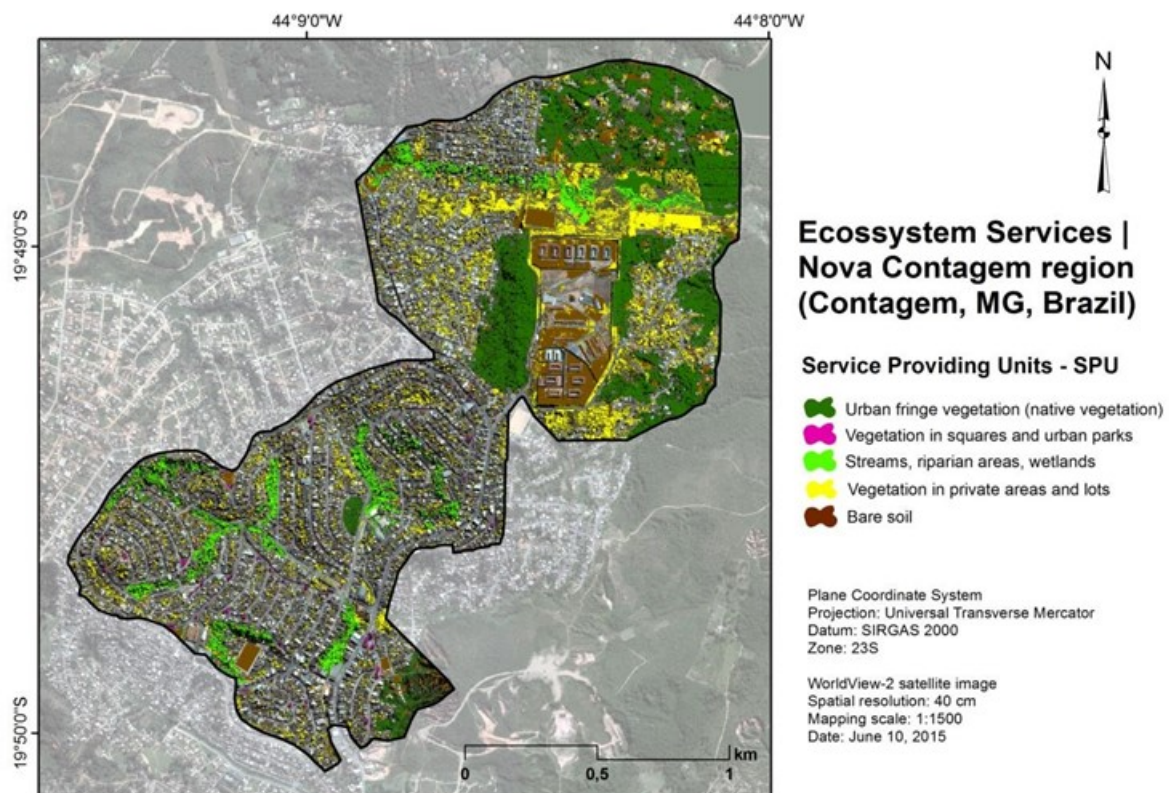


Figure 5 – Service Providing Units in Nova Contagem

Table 1 – Service Providing Units (SPUs), Spatial and Temporal Scale

Ecosystem service	SPU	Spatial scale	Temporal scale
Provisioning			
Food: fruits and vegetables	1,2,4	Local	Seasonal

Food: fish	3	Local, regional	Seasonal
Drinking water (surface and groundwater)	3,5	Local, regional	Constant or seasonal
Ornamental vegetation	1,2,4	Local	seasonal
Wood and fiber	1	Local, regional	Constant or seasonal
Natural medicines	1,2,3,4	Local, regional	Constant or seasonal
Energy production	1, 3,4	Local, regional	Seasonal
Mineral raw materials	5	Local, regional	Constant
<hr/> Regulating			
Erosion control	1,2,3,4	Local	Event, constant
Flood control	1,2,3,4	Local, regional	Event
Storm water runoff mitigation	1,2,3,4,5	Local	Event
Water quality enhancement	1,2,3,4,5	Local, regional	Constant
Water cycle	1,2,3,4,5	Local, regional	Constant
Air purification/air quality regulation	1,2,3,4,	Local, regional	Constant or seasonal
C sequestration/storage	1,2,3,4	Local/Regional	Constant or seasonal
Temperature regulation	1,2,3,4	Local, regional	Seasonal, event
Noise reduction	1,2,3,4	Local	Constant, event
<hr/> Supporting			
Carrier services: Transport of water, sediments, chemicals by water	3,5	Local, regional	Constant
Geological substract for crops and buildings	5	Local	Constant
Storage capacity for water, humidity	3,5	Local, regional	Constant, seasonal
Soil formation	1,,3,4	Local	Seasonal
Biodiversity support	1,2,3,4,	Local, regional	Constant
Nutrient cycling	1,2,3,4,5	Local	Constant, seasonal

Cultural			
Aesthetic value	1,2,3,4	Local-regional	Constant,
Recreation and cognitive development	1,2,3,4	Local-regional	Event, seasonal, constant
Educational opportunities	1,2,3,4,5	Local, regional	Constant, seasonal, event

Temporal and spatial scale classification based on Anderson et al, 2015

Table 2 exemplifies the qualitative ES potential assessed for the three target areas of Nova Contagem (NC) Tupã and Solar do Madeira (figure 4); Bradshaw et al. (2017) provides a complete assessment.

Table 2– Potential ES Delivery in Nova Contagem - examples

PROVISIONING		
Ecosystem services	SPU	Qualitative assessment
Drinking water (surface and groundwater)	3,5	Nova Contagem (NC) neighbourhood and the neighbouring urbanised areas are all located in the Agua Suja stream catchment. The Agua Suja stream is a direct tributary to the Vargem das Flores reservoir. This reservoir provides drinking water for the Metropolitan Region of Belo Horizonte. The urban streams in the NC study area do not provide drinking water locally, all contributions are concentrated in the reservoir, treated to reach conditions of drinking water and then distributed.
REGULATING		
Ecosystem services	SPU	Qualitative assessment

Erosion and flood control, water purification	1,2,3,4	<p>All these SPUs play a relevant role on erosion and flood control, stormwater runoff mitigation and water quality enhancement in the target areas. The urban fringe native vegetation occupies a small area of the NC study area. This vegetation located in narrow and deep valleys and in steep hillslopes can deter the development of intense erosion processes. Urban squares play a minor role in erosion control and runoff reduction mainly because even when equipped with large canopy trees, most of the surfaces are paved and surface water is directly drained to the mains. In other terms, squares are not conceived as potential structures to promote rainwater infiltration and to reduce runoff. Conventional urban drainage may result in aggravated erosion processes downstream of the study area. There are almost no trees or other vegetation in the streets of central Nova Contagem. Nevertheless, many dwellings have trees and greenery in their backyards, playing an important role in intercepting and promoting infiltration of rainwater and reducing runoff, with positive impacts on erosion control. In contrast with usual urban practices during the 20th Century in Brazil, some of the riparian areas of the abundant urban streams have not been developed and streams have not been lined. Field visits determined that trees typically present in riparian areas in this environment have been removed, although some still exist, particularly along the borders of the streams. Nevertheless, the existing vegetation cover mainly composed of fields of grasses and bushes play an important role in absorbing runoff produced by the road system and other impervious areas nearby, reducing runoff velocity, producing some infiltration and acting as buffer zones for the streams in the bottom of the valleys. These buffer zones are therefore very positive in terms of erosion control and diffuse pollution abatement. Field visits also determined that most of the stream reaches which are part of riparian areas are stable and one cannot identify process of intense stream bed erosion, pointing out that the riparian areas are playing a positive role on reducing the impacts of the changes in flow regime caused by urbanisation. Regarding flood control, the large riparian areas are relevant in reducing flood risk and flood damages.</p>
SUPPORTING		
Ecosystem services	SPU	Qualitative assessment

Geological substrate for crops and buildings	5	The NC target area, considering only the area where the interviews and walks were performed, has an area of 3,02 km ² . It is located in a large region of limestone outcrops over river terraces in between the fluvial plains of the Paraopeba and Velhas rivers. The local geological characteristics suggest that the substrate for buildings is adequate not offering risks of landslides. Very steep areas are mostly protected by dense vegetation which contributes to structure the soil, reducing landslide risks and erosion.
CULTURAL		
Ecosystem services	SPU	Qualitative assessment
Recreation, cognitive development, social cohesion	1,2,3,4	According to observations made during several field visits, natural vegetation in the urban fringe and in the riparian areas are not regularly used for recreation or cognitive development. Larger squares and those located near commercial areas are frequently used and one can find many people in this kind of urban equipment all day long, resting, chatting, observing vegetation and life going by. It is possible that some commercial activities also take place in those squares. The lake of Vargem das Flores is clearly a destination for sport practices and recreational activities, such as swimming, waterskiing, fishing, sun bathing, picnicking, among others. Informal bars exist along the lake shore where people socialise.

The majority of the ecosystems services identified in the target area are hydrological and pertain to the water provisioning function of the Vargem das Flores reservoir. Notably, many are significant at the regional level while also benefitting the local ecology and communities (Table 1). The above qualitative assessment indicates, that in the Nova Contagem area, some SPUs are not providing ecosystem services to their full potential, or due to inadequate intervention or lack of maintenance and bad management, they are providing disservices. This is, for instance, the case with unpaved roads in the urban area, particularly those located in steep hillslopes typically found in the Tupã neighbourhood. Areas of bare soil are a source of sediments that will settle in the riparian areas, streams, the Vargem das Flores reservoir and other water bodies and reduce transparency of the water with an impact on the ecology of these environments.

Lack of sanitation infrastructure is a source of water contamination as it is associated with the dumping of raw sewage in streams and other water bodies. This is a source of many disservices such as aesthetics, odour, nutrient cycling and eutrophication processes in streams and in the Vargem das Flores reservoir, as well as adverse health issues. Poor solid waste management leading to litter and trash being disposed particularly in riparian areas and the borders of the Vargem das Flores reservoir contributes to reduce the aesthetic value of these areas, is a source of bad odour and attracts rats and mosquitoes that can spread the dengue virus. Rubbish may also block water flow in streams and

drainage structures aggravating the consequences of floods. In addition to the ecological impacts of wastewater, solid waste and excessive amounts of sediments in the riparian areas and water bodies, these pollutants compromise the use of water for drinking purposes and may give rise to arguments in support of stream channelling. This assessment of potential ES supports the assumption that incomplete urbanisation and particularly the lack of sufficient sewage networks undermine the provision of ES and underpin the significant disservices provided by the urban streams in the target areas.

3.3 Assessing experienced environmental quality and its mediating factors

Qualitative data gathering comprised 24 in-depth interviews with a range of purposively sampled residents in the three target areas. In addition, accompanied walks employing the Urban App (Juntti et al. 2015; Juntti and Lundy 2017) to record environmental features that the respondents experienced as particularly significant to their daily lives and in the neighbourhood more generally were undertaken with ten participants, some of which had also been interviewed. The walking routes were agreed in collaboration with the respondents, and the deployment of the Urban App was respondent led. While the Urban App enables the recording of short textual comments, due to poor network coverage, this was not used and the app was used only to record a geo-referenced image. In addition, a 'walking narrative' where the respondent explained the route and the significant sites along that was recorded and transcribed.

The aim of the qualitative data collection was to gain an understanding of the overall liveability of the three target neighbourhoods (e.g. van Dorst 2012) and the function of the green spaces and water features within that. Both the in-depth interviews and the walking narratives aimed to elicit the respondents' views on the following themes: general information on the respondent's background; the neighbourhood in question and its liveability; work and mobility options; quality and function of green areas in the neighbourhood, its vicinity and the Vargem das Flores reservoir; knowledge of and attitudes to environmental issues more broadly; perceptions of risks and threats in the neighbourhood; and political engagement and local policy and planning. All transcripts were analysed with help of the NVivo software. The Urban App photographs were drawn on to aid the cross-referencing of the interview material and the ES assessment presented above. The photos and walking narratives enabled the association of specific benefits and dis-benefits described in the narratives to be associated with specific type of SPUs.

The open thematic analysis (e.g. Bryman 2016) of the interview and walking narrative material started with the identification of the processes of engagement and the subsequent functions of the environmental features of the case study areas, described by the respondents. These latter comprise both physical and interpretative processes of engagement and the data suggests that in addition to offering many types of directly experienced beneficial services, the environmental features are also assigned various individually and communally recognised signifying functions that condition how they are accessed and engaged with in the residents' daily lives. The emerging interpretations of ES and EDS were then analysed for contingency to contextual factors, those associated with liveability (e.g. van Dorst 2012) such as perceptions of community cohesion, diversity and inequalities, perceived community needs and level and quality of service provision, perceptions of existing environmental quality and problems, issues of access and perceptions of levels of crime but an openness was maintained to further contingencies that might relate more specifically to the

manifestations of incomplete urbanisation in the target areas. Subjective factors such as identity and capability to engage also brought some variation in the experienced ES and EDS (Fischer and Eastwood 2016), and these are further explored in terms of the gendered differences in Bradshaw et al (2017). For the purpose of including quotations from the interviews in the discussion of findings, all interviews were anonymised and labelled according to their home neighbourhood, where NC= Nova Contagem, T=Tupã, SM= Solar do Madeira and W=walking narrative.

4. Lived, experienced and interpreted environmental quality

The interviews with local residents reveal a range of engagements with local environmental features that mostly mirror those provisioning, cultural and regulating ES outlined in the vast literature on urban and peri-urban ES (e.g. La Rosa et al. 2015). The respondents describe both passive knowledge and appreciation (or dislike) of, and active physical engagements with the SPUs identified in the above ES assessment. The interview data demonstrates how SPUs are assigned functions and these functions are then interpreted (co-constructed) as either beneficial (ES) or harmful (EDS) (Table 5 section 4.3): *“The role of the green is... It improves the conditions, doesn’t it, the air, and also, it is... visual, isn’t it? It becomes much better.”* (R8 NC) but *“I had a jurubeba tree there, which is the fruit the pigeons like. ... But then the neighbour complained, he said that a lightning could hit the tree, and so on...”* (R8 NC). These normative constructions then often inform active engagements with greenspace. But also descriptions of active engagements with SPUs or mobilised (co-produced, Table 3, section 4.1) ES are often normative: *“... people plant a lot, fruit trees, you know. Squares are very well taken care of.”* (R6 NC). Interview respondents describe a range of negative interactions with the SPUs (co-production of EDS) (Table 4, section 4.2) : *“People have more excuses, because there are bushes, ... I think they take advantage of this issue to use it to discard waste”* (R6 NC).

Despite this complexity in how SPUs and engagements with them are interpreted and translated into experienced ES or EDS, our data demonstrates that the residents of the studied neighbourhoods gain a broad range of benefits from greenspace, whether actively engaging with it or not. Below, we first outline and interrogate the ES that can be termed as actively co-produced. In section 4.2 we acknowledge that both the SPUs and active engagements with them can also be experienced as negative, and yield disservices (EDS). In section 4.3 we then move to assessing ES and EDS are engaged with to order and classify spatial distinctions in this context of incomplete urbanisation and to support behaviours that are central to place identity, belonging and that often contribute to experienced agency among the residents of these peripheral and predominantly poor urban settlements. The range of contextual factors that condition how active and passive engagements with urban nature translate into positive services or negative disservices is discussed throughout the three sections. Although our target areas vary in terms of the range and abundance of reported ES (see also section 3), there are several examples of the material and signifying functions assigned to urban greenspace in all in all of them. We have used the SPU categorisation devised in the science led ES assessment to organise the presentation of the reported experienced ES in tables 3-5. It was possible to connect most descriptions of ES and EDS to an SPU, and this has been aided by the app walk narratives and photographs taken during the walking interviews (Images 1-7). In many cases, a described ES or EDS pertained to a number of SPUs.



Image 1.



Image 2.



Image 3.

Images 1-3. Street trees and an urban square in central Nova Contagem, and fencing cordoning off the Nosso Rancho gated community in Ipê Amarelo. (Source: interview respondents through the Urban App)

4.1 Wellbeing and active engagements with nature

As shown in Table 3, in our target areas most active engagements with the greenspace represented by the six SPUs take the form of the conventional cultural ES: recreational activity, hiking or more leisurely walking and picnicking of just ‘socialising’ in urban squares – venturing out to enjoy some aspect of the available greenery. Engagements with provisioning ES are also common, caring for urban gardens and foraging from urban squares and urban fringe vegetation as well as fishing in some of the urban streams and the Vargem das Flores reservoir. The reservoir on which both Tupã and Solar do Madeira border lends itself to swimming and motorsports, having attracted a cohort of makeshift bars. Other parts of the shoreline are used for religious rituals (macumba). Some of these ‘active ES’ have opportunity costs and are often portrayed as incompatible.

Urban greenspace clearly contributes positively to residents’ wellbeing in terms of offering increased opportunity for physical and social activity in all three neighbourhoods. But the interviews suggest that there is much less scope for active enjoyment of urban nature in central Nova Contagem, the type 1 housing estate, than in older and more peripheral parts that represent housing types 2 and 3 (self-built houses on plots bought from a third party and completely spontaneous occupations of land respectively). In central Nova Contagem, the ES assessment identified urban greenspace mainly situated in back gardens and in the riparian areas of urban squares, and in line with this, quality of public greenspace is described as poor and insufficient by respondents. Moreover, fear of crime forms a significant barrier to accessing public areas and litter is a recurring issue particularly with the riparian zones of urban streams being used for rubbish dumping and reported as a negative feature producing mainly EDS in Nova Contagem. However, the provision of basic utility services such as electricity and sewage networks, post and waste collection and the provision of shops and schools is

better than in more peripheral neighbourhoods. So in our data, there is no direct correlation with extent of incomplete urbanisation, associated deprivation, and lack of ES at this neighbourhood scale. In the more peripheral Ipê Amarelo and Bougainville as well as in Tupã and Solar do Madeira which border the reservoir, greenspace is abundant but there are more symptoms of incomplete urbanisation relating to poor service provision and frequent new land occupations. Fear of crime appears lower than in central Nova Contagem and urban nature is actively engaged with. Solar do Madeira, which is almost completely informally developed type 2 settlement is marked by larger individual housing plots and residents that tend to be of middle to high income. Overall then, in our target areas, housing density rather than urban service provision or housing status is the main factor hampering both scientifically detected and experienced ES. In central Nova Contagem, gradual urbanisation has been at the expense of urban nature but service provision has improved with higher household density.

Table 3: actively co-produced ES and contextual factors that condition their co-production

SPU	Actively derived ES	Contextual factors
1. Native vegetation at urban fringe	<ul style="list-style-type: none"> • Accommodating communal activities such as socialising, walking or picnicking with friends • Provisioning services: especially fruit and medicinal plants • Accommodating motor sports • Affording relaxation and 'escape': enjoying tranquillity, especially at locations which afford a view and further off locations with country houses often owned by a relative or a friend. 	<ul style="list-style-type: none"> • Fear of crime limits willingness to engage. • Foraging for edible and medicinal plants is dependent on knowledge that is often passed down generations. • Overcrowding and other noisy or dangerous recreational practices compromise other ES.
2. Vegetation in squares, urban parks and streets	<ul style="list-style-type: none"> • Accommodating communal activities: congregating and socialising, planting and gardening urban squares (in central Nova Contagem). • Providing shade from the sun and cooling effect (Image 1). • Accommodating exercise: ballgames (some squares have gym equipment and/or gym classes; Image 2). • Affording relaxation and 'escape': urban greenspace in some of the less densely populated areas such as Bougainville, Esmeraldas and Tupã is reported to provide this service although to a decreasing extent. 	<ul style="list-style-type: none"> • Fear of crime limits access and willingness to engage. • Low availability of greenspace especially in central Nova Contagem limits engagement. • Expanding development limits available greenspace within neighbourhoods.

3. Streams, riparian areas, wetlands	<ul style="list-style-type: none"> • Providing aesthetic enjoyment (Vargem das Flores reservoir). • Accommodating communal activities; the Vargem da Flores reservoir is a popular place to visit with friends and spend the day picnicking (Image 4); festivals and religious rites are also performed at the reservoir. • Accommodating motor sports: jet ski and motorbikes on or in the vicinity of the Vargem das Flores reservoir. • Accommodating exercise: walks along urban streams and around Vargem das Flores; swimming at Vargem das Flores. • Provisioning services: fishing in the larger streams and the reservoir. • Affording relaxation and 'escape': larger streams further off are frequently mentioned as yielding this service; Vargem das Flores used to be popular for this and still is for some. • Accommodating communal activities such as congregating with friends and family (only Vargem das Flores). • Accommodating spiritual rituals (macumbas, despachos; only Vargem das Flores). 	<ul style="list-style-type: none"> • Drought that has led to low water level makes the reservoir less attractive for recreation and aesthetic enjoyment. • Overcrowding limits access and enjoyment. • Noisy water sports such as jet skiing limit tranquillity. • Lack of supervision and sanitary infrastructure decreases the willingness to engage with this ES. • Concerns over water quality limit fishing and swimming.
4. Trees in private gardens / plots, urban agriculture	<ul style="list-style-type: none"> • Providing shade (trees are deliberately planted and cared for for shade). • Provisioning services: fruit, vegetables, pigs, poultry, medicinal plants; these are all grown mostly in private back gardens although there is a mention of a communal garden. 	<ul style="list-style-type: none"> • Decreasing space due to housing needs limits provisioning services.
5. Soil	<ul style="list-style-type: none"> • N/A 	<ul style="list-style-type: none"> • N/A

In terms of contribution to wellbeing, the existing greenspace especially in the less densely developed neighbourhoods affords good scope for physiological benefits (WHO 2016) and there are examples where ES can be seen to support the basic needs of poor households. Fishing is a particularly pertinent provisioning service in areas where access to the reservoir and larger streams is possible. It is very likely that this local provisioning ES supports a healthy diet for some residents, and some report selling the catch. Fruit from wild and domestic trees are also harvested by many.

Like the frequently mentioned medicinal use of plants, this kind of foraging is dependent on local knowledge, passed between generations. This also demonstrates the role of urban greenspace in sustaining traditional knowledge and practices.

“[R]: Yes, there are, there are lots of them. From the forest, we eat gabioba, goiabinha do mato...

[I]: And how do you know what you can eat, ... ?

[R]: Yes, [from] the old people, right?” (R23 SM)

But overall, even in the peripheral neighbourhoods, the interviews describe a declining ES provision. While urban fringe vegetation continues to provide opportunity for walking and foraging, it is increasingly impinged on by development, as exemplified by the below quote from a long term resident.

“[R]: It was so beautiful there, it was so beautiful, ... when I was a child, there was a natural water source that you could have the safety of drinking water from that source, crystalline water.

[I]: And nowadays that source does not exist anymore.

[R]: Nowadays, it does not exist anymore, it is all urban area, there are houses there.” (R1 NC)

In central Nova Contagem, the same applies to back gardens which constitute an important SPU there. In a typical example, the below quote describes a situation where a back garden has been sacrificed to accommodate adult children and their families.

“...my husband said that today... “Good times, when we used to grow vegetables, we had everything, lettuce, chicory, cabbage, carrot...” He grew everything, then she had to build her house, and it was over.” (R2 NC)

Provisioning services from vegetable plots and foraging are still well evidenced in the more peripheral areas (for both housing types 2 and 3), especially where there is better access to urban fringe vegetation such as in Tupã where the below respondent lives. However, even in these areas, access is becoming more restricted due to land being marked for development.

“[R]: We used to pick up lots of jabuticaba, guava, and other fruit.

[I]: In the woods?

[R]: Yes. In some of those areas as some are private and we cannot enter.

[I]: But did you go in anyway?

[R]: Yes, there is no one there, there are places we already know how to get in but others they put guard dogs to intimidate us, but other than that we went there with no problems. We used to get even palm plant.” (R14 T)

This is a common occurrence in areas where there is type 2 housing development facilitated by private landowners (e.g. Image 3). While the identity of and means whereby these social agents have acquired the plots and the status of ownership often remains ambiguous, many of our respondents use the derogatory term ‘invasions’ to describe the emerging type 2 and type 3 development. These new plots and dwellings in the more recent parts of Nova Contagem such as Ipê Amarelo and Bougainville and particularly in Solar do Madeira tend to be larger than the standard

plots in the formal areas and afford a broader range of ES. The below quote from a central Nova Contagem resident describing the different fortunes of more recent irregular settlers demonstrates that this may be frowned upon:

“[R]: ...they are irregular areas, right, there are people who have a larger plot, they can plant, there are people who do not, right? ...

[I]: But how about animals, hens, are there these things?

[R]: There are many animals, hens... I see many of them, hens, more in the back of the neighbourhood, in the part where there was an invasion, right? Because when there's the part that is invasion, ... , they don't take those standardized plots that were at the time of the donations, then they take a larger plot...” (R33 NCW)

Despite many of our respondents having themselves originally obtained access to housing through occupation, the legitimacy of new spontaneous occupations is widely contested, often due to its role in limiting the availability of ES.

“here was a farm, right, which was expropriated, and it was full of mango trees, standing jabuticaba, you should have seen what a delight ... all gone! Ended! They were invading, invading, invaded, invaded, built, and over, over it all. And if you make an area to be preserved, if you do not create a reserve, it will disappear because the rest of the people are coming, okay invading!” (R9 NC)

Many respondents dispute the legitimacy of further land occupations particularly where it is seen as speculative privatisation by stealth.

“I go walking, we see many plants, many trees, many fruits, and we can even collect because this is a public property, there is no owner, right? And some people make a fence, like my uncle who lives there, he makes fences, but it does not belong to him.” (R25 NCW)

While we did not speak with any land agents or newly arrived occupants, it is likely that the increase in undeveloped but cordoned off plots represents speculative land occupation that aims to benefit from the plans of the new municipal government to increase housing development in the area.

“About five years ago over here it started getting more polluted because the people started to notice the bush and ... began to invade. ... they burned the bush, it was marked. They do not even build, but burn them, then began to pollute the air, and so on... Before it was very easy for you to see squirrels, monkeys, such animals, today it is very rare.” (R34 TW)

In addition to restricted availability, in central Nova Contagem the main contextual factors conditioning the ways residents engage with what little greenery remains present in their neighbourhoods relate to perceived risk of crime, decreased quality of greenspace due to overcrowding, and litter. Many respondents describe avoiding urban squares and even the reservoir due to the risk of crime and anti-social behaviour. This is particularly prevalent in the densely populated central Nova Contagem.

“... with the violence that we have in the neighbourhood, people are afraid to go out, to go to the parks” (R5 NC)

Fear of crime appears to decrease the capability of specific groups of the population to benefit from existing urban greenspace. The interviews reveal that people feel afraid to let their children play

outside due to violence associated with the selling of drugs and avoid public areas where possible. Some have lost young male family members, who are described as particularly vulnerable to this type of crime in the area. This below female respondent describes how limited opportunity there is in her neighbourhood for her sons play outside:

“[I]: So, your boys, where they play?

[R]: Only here in the yard, or the bit, to the gate here. ... We do not let them out.

[I]: Are you scared?

[R]: It's fear, right? And nowadays everybody's using these boys to do such evil ... so much ... At least I do not let [them] out at all. Me, when we want to walk somewhere, or we go in the house of a distant relative, or go to Eldorado, the Big Shopping [centre] Itaú, these places as well, because there's no way to let them loose [here].” (R5 NC)

This suggests that children, perhaps especially boys have limited engagements with urban ES not just because there is low provision in central Nova Contagem but also due to the nature and level of experienced risk of crime in the neighbourhood. The high level of crime appears also to have implications for community relations – some respondents report feeling stigmatised and therefore potentially limit their use of public places.

“the people involved in the drug world, ... , are the black people and the police arrive already acting with violence. If you see a black person on the street you already think he is a suspect, ... once at our doorstep, my brother and I were waiting for a pizza we ordered, the armed police arrived came to us and said: ... "and what are you doing out on the street?"” (R7 NC)

Moreover, Bradshaw et al. (2017) identified a gender bias in recreational ES, where it is mainly men who access and enjoy the wooded landscapes of the urban fringe. This is also evident in the below quote from a male Nova Contagem resident, describing the wooded landscapes surrounding the reservoir:

“Well, it was one of the prettiest landscapes I had here... Men can go anywhere, but women unfortunately don't go and they don't want to. There are some beautiful places to pass through in small routes, and you forget entirely about the violence here, these are really beautiful places.” (R25 NCW)

It is not possible to say whether the above quote reflects higher perceived risk to women from crime or a view of acceptable gender specific behaviour (Mortimer-Sandilands 2005). But access to ES appears limited by gender and age, with women and children, especially boys, potentially benefitting less. This is particularly unfortunate as research increasingly testifies to the multiple benefits that children and pregnant women receive from being able to spend time in natural surroundings (WHO 2016).

Finally, there are also co-produced ES that decrease the value of other ES. For example, the peace and tranquillity offered by the Vargem das Flores reservoir is compromised by motor sports and high numbers of visitors not only from neighbouring but also distant communities. This makes the

reservoir less attractive for the local population who are used to visiting with their families to enjoy quiet time off and the aesthetic benefits of the reservoir.

“I: Why did you stop going [to the reservoir]?”

R: Ah, too much turmoil. There is a lot of mess, the people will drink... That's very, very messy.” (R5 NC)

So while it is fair to say that in our target areas hallmark symptoms of incomplete urbanisation such as shortcomings in public services like policing and amenity management, and ongoing informal land occupations clearly impede the ability of locals to actively benefit from the local ES, our respondents often suggest that rather than the municipal authority, it is community members themselves, and in particular, newcomers and visitors who are responsible for the decreasing quality of urban greenspace. The lack of care and responsibility demonstrated by the leisure users of the reservoir, is cited as a significant obstacle to the realisation of many potential ES and a reason why many SPUs are seen as yielding only EDS. Elements of othering and belonging are clearly at play in the descriptions of acceptable behaviours and uses of greenspace, which suggest that ES are implicated in social identity construction and place making in multiple ways. This also seems to play a central role in the construction of EDS, as discussed in the following section.

“People here [in Solar do Madeira] know how it is, they are preserving what belongs to them, now those who come from outside do not care, if it is beautiful, if the air is healthy, they do not care, they want to make a mess, they want to enjoy themselves...” (R28 SMW)



Image 4.



Image 5.

Images 4 and 5: SPU 5 urban water features, the Vargem das Flores Reservoir and an urban stream in central Nova Contagem. (Source: Interview respondents through the Urban App)

4.2 The production of ecosystem dis-services

From the point of view of the metropolitan planning process, the main function of the territory surrounding the Vargem das Flores reservoir is water provision. This is visible in the zonal land-use restrictions in place around the reservoir, pertaining to both Tupã and Solar do Madeira target areas. But while the Vargem das Flores reservoir and particularly the urban streams that form tributaries to

it were in the science led assessment identified as providing significant water provisioning ES at metropolitan level, they are in the interviews mainly associated with negative functions yielding EDS (Table 4).

“[I]: ...in terms of pollution, what do you think is the major problem here?

[R]: This stream. People throw a lot of garbage.” (R5 NC)

As a result of waste dumping, the streams flood easily and many respondents refer to the need to canalise them. This would mean covering them altogether and would omit a range of ES provided by the riparian areas (detailed in section 3 above), impact on water quality in the reservoir and ultimately on the treatment costs for drinking water. Moreover, the satellite image (Figure 4) shows that the riparian areas of the urban streams are the most abundant SPU in central Nova Contagem where greenspace is scarce. But in the residents’ daily lives, omitting the experienced EDS seems to trump any loss to water provisioning ES:

“[I]: ...these streams in Nova Contagem, many of them are, at least part of them, are channelled, ... do you think it is good or bad?

[R]: No, I think it is great, right. Because ... especially that stream passing through Retiro, ... It was a headache for us, because every year during rainy season, flooding occurred.” (R4 NC)

There appears therefore to be a scalar conflict pertaining to the urban streams that mirrors the rift between the municipal and metropolitan planning interests (Eleuterio et al. 2015). For whatever reason, the open streams have become recruited into the practices of waste disposal. This renders them problematic from the point of view of many residents, and according to both the interviews and the science led ES assessment, yields agency to pests and the dengue virus. But contrary to the beliefs of the residents who support covering the streams, findings by Knauer et al. (2011) suggest that this kind of channelling would not mitigate flooding or the pooling of water, and moreover, would lead to the loss of the range of indirect ES provided by the riparian zones. Therefore, the question remains of how to disrupt the unwanted relations of agency underpinning the EDS. The below quote from a resident of central Nova Contagem suggests that the level of maintenance of public spaces by the municipality can discourage behaviours that produce EDS. The quote demonstrates how notions of care, responsibility and perceived risk of crime intertwine to condition the production ES and EDS from urban parks.

“[I]: Bushes, then, are an excuse to discard waste?

[R]: That’s right, at the moment, not so much, because they started weeding here, but there are times when it becomes so closed that I think that it may also serve as a hiding place.

[I]: A hiding place for what?

[R]: For bandits, you know. “ (R6 NCW)

While there is much criticism of the level of care and responsibility expressed by residents themselves in looking after the neighbourhood and this is clearly significant in the realisation of EDS (e.g. Mee 2009), there is therefore also an allusion to the significance of care and investment by the municipal authority here. By neglecting greenspace management (and solid waste collection) in

these neighbourhoods, the municipal authority is seen to sanction antisocial behaviours such as littering and criminal activity.

Similar fall out from the scalar rift in planning interests is evident at the Vargem das Flores reservoir. Though Copasa, the water company that owns the reservoir, managed to engage both state level and municipal authorities in issuing development restrictions and regulating land management in the catchment area, this has not prevented the proliferation of small businesses selling drinks and food and supporting a lively leisure scene on the shores (e.g. Image 4). However, due to the informal status of this development, there is no waste collection or provision of public sanitation facilities and the environmental protection status arguably adds to the reluctance of the municipality to provide these. This has led to situation where beach tourism bears significant opportunity costs for other ES that could benefit the local community as well as water quality and is increasingly associated with the provision of EDS. Respondents suggest that while the ability of the reservoir to attract visitors and create a positive atmosphere is important for many and fundamentally positive, the reservoir needs management in order to avoid these potential ES being translated into negatives (see Table 4). Moreover, unsupervised use of the reservoir is perceived to pose high risk to health and safety.

“[I]: But now has the popularity [of the reservoir] decreased?

[R]: Yes, decreased, because of the drought, pollution and deaths as well, people that swam were they should not [and] drowned.” (R3 NC)

To sum, the notion of care is central to sanctioning behaviours that underpin the problems associated with urban greenspace. While poor municipal service provision clearly underpins the production of many of the EDS, much of the blame is placed on the level of care and responsibility exhibited by residents themselves in the interviews. Here, the relationship between incomplete urbanisation and EDS is more evident and more investment, supervision and management by the authorities would likely lead to less antisocial behaviours and littering on the part of local residents and visitors alike. However, here investment is limited due to environmental designations rather than lack of potential economic returns. The problems associated with the lack of services at the Vargem das Flores reservoir demonstrate that poorly implemented and enforced environmental designations that overlook local level needs and lack legitimacy can be extremely counterproductive.

Table 4: EDS and associated contextual factors conditioning their co-production

SPU	Ecosystem Dis-Service	Contextual factors
1. Native vegetation at urban fringe	<ul style="list-style-type: none"> • Harbours criminal activity by providing visual shield and place to congregate. • Limiting development and economic activity. • Increasing fire risk. 	<ul style="list-style-type: none"> • Lack of policing; criminal gangs and drug dealing are common in the area. • Environmental protection regulations and the forthcoming ZIM status. • Land occupations and associated burning of vegetation.

2. Vegetation in squares, urban parks and streets	<ul style="list-style-type: none"> • Obstructing mobility and posing traffic risk (mainly street trees). • Encouraging criminal activity by providing visual shield and place to congregate. 	<ul style="list-style-type: none"> • Low maintenance of public greenspace by the municipality.
3. Streams, riparian areas, wetlands	<ul style="list-style-type: none"> • Causing and or spreading diseases – waste dumped in waterways results in pooling and risk of dengue mosquitoes; • Enabling waste dumping. • Increasing flood risk. • Providing risk of accident. • Harboursing excrement and other un-hygienic waste. 	<ul style="list-style-type: none"> • Poor waste management services. • Lack of care and feelings of responsibility among residents. • Overcrowding; lack of policing / supervision of activities at the reservoir. • Lack of sanitation services (at the reservoir).
4. Trees in private gardens / plots	<ul style="list-style-type: none"> • Harming buildings (trees increase the risk of lightning strikes; roots). 	<ul style="list-style-type: none"> • Subjective risk perceptions / knowledge
5. Soil	<ul style="list-style-type: none"> • Erosion and run-off from bare soil; landslides. 	<ul style="list-style-type: none"> • Unpaved roads. • Land clearing for new occupations (housing types 2 and 3).

4.3 The co-construction of ecosystem services, spatial hierarchies, agency and belonging

Table 5 displays the ES that do not involve physical co-production but that nevertheless serve a function as a part of the neighbourhood for the interview respondents. Here, the signifying function of ES and EDS comes to the fore as they are recruited collectively and subjectively into relations of identity, place making and belonging (Murdoch 1998; Massey 2004; Mee 2009).

Table 5: Passively enjoyed experienced ES and the contextual factors that condition their co-construction

SPU	Direct ES	Contextual factors
1. Native vegetation at urban fringe	<ul style="list-style-type: none"> • Increasing aesthetics of neighbourhood • Air purification • Supporting species / biodiversity • Improving atmosphere and tranquillity of the neighbourhood • Combatting climate change • Increasing soil stability 	<ul style="list-style-type: none"> • Level of maintenance of greenery. • Subjective preferences • A degree of scientific knowledge and understanding (of air quality; species; climate change; water and soil based processes)

2. Vegetation is squares, urban parks and streets	<ul style="list-style-type: none"> • Increasing aesthetics of neighbourhood • Air purification • Improving atmosphere and tranquillity of neighbourhood • Combatting climate change • Marking type of community <ul style="list-style-type: none"> ○ Abundance of green features and good level of maintenance were associated with tranquil neighbourhoods, and caring residents, areas favoured by peaceful family oriented people. ○ Overgrown greenery, lack of maintenance and litter were associated with lack of care and higher risk of crime within the community. • Discouraging anti-social behaviour and crime 	<ul style="list-style-type: none"> • Subjective preferences • A degree of scientific knowledge and understanding • Level of maintenance of greenery • Differing planning status of settlements / housing • Ongoing informal occupations of land for housing • High risk of crime and anti-social behaviours
3. Streams, riparian areas, wetlands	<ul style="list-style-type: none"> • Attracting visitors and contributing to liveliness of the area (only applies the Vargem das Flores reservoir) • Water provision. 	<ul style="list-style-type: none"> • Remote/peripheral location or seclusion for other reasons • Subjective preferences • Knowledge / awareness of water management
4. Trees in private gardens / plots/ urban agriculture	<ul style="list-style-type: none"> • Supporting species / biodiversity • Indicating planning status – irregular plots are bigger and accommodate more greenery and even domestic animals 	<ul style="list-style-type: none"> • Differing planning status of settlements / housing (existence of informal development)
5. Soil	<ul style="list-style-type: none"> • Marking spontaneous informal land occupations (development model 3) 	<ul style="list-style-type: none"> • Differing planning status of settlements / housing • Ongoing informal occupations of land for housing • Lack of paving by the authorities.

Urban greenspace plays a role in the construction of place identity at the level of neighbourhoods and streets in all our target areas. As discussed above, the state of vegetation and associated level of management and care is particularly meaningful to our respondents. The below quote describes the derelict state of the urban squares in central Nova Contagem, demonstrating how visible neglect and risk of crime are associated and mark place identity and contribute to perceptions of safety.

"...squares which are not very well cared, the bushes grow, the waste increases, there aren't many trees, ... these are not places for you to take the children to ride a bike, they are not good places for you to stay with your husband, your wife.

[Y]: Do you think they are dangerous places?

[A]: They are dangerous and neglected places..." (R1 NC)

Neglect by authorities is a central theme in discourses of liveability and public space throughout our target areas. In Tupã, a secluded small settlement bordering the reservoir, which suffers from low frequency and quality of public transport and poor road quality, this is attributed to the small political weight of the neighbourhood: *"they [authorities] are generally concerned with the most populous places, here, the amount of votes here is very small, you know."* (R16 T). Moreover, although housing in central Nova Contagem is formal, it constitutes an example of displacement, where people were moved into allocated housing in the 1980s and several of our respondents, who are newer arrivals have also acquired a residence here by necessity rather than by choice, having been rehoused from other less suitable locations. In theory, a history of displacement and evident neglect undermine feelings of belonging and positive place identity (e.g. Mee 2009) but in our target areas, narratives of belonging and strong place identity are evident:

"We had difficulties here, as I have already mentioned, in the beginning it was very difficult. The streets were not paved, there was no water, no electric power, there was nothing... The neighbourhood was not very... It did not have a good reputation, it was very defamed... Even today it still has a bad reputation, but most of the people already see this place in a different way. ... I would say that this is a place, a good region, for living." (R8 NC)

Despite the shortcomings in service provision, mobility and opportunities, people have made the neighbourhoods home. In the housing estate of central Nova Contagem, the arid landscape of the early years with rows of identical small houses has transformed into one of diverse remodelled houses (Image 6). Though these houses are protected by high walls in an effort to combat crime, satellite images and interviews reveal back gardens, often with trees that are rarely visible from the streets. Our interviews suggest that behind the walls many social relations take place in a multitude of ways characteristic to the flow of everyday life. The standardised dwellings have been appropriated and modified to respond to resident needs and preferences and together with the slowly improving services and commerce, residents now clearly feel a sense of belonging and pride.



Image 6. The central Nova Contagem neighbourhood: an almost original house in the bottom right of the picture and three retrofitted houses towards the top of the hill (Source: Bradshaw et al. 2017).

In fact the peripheral location of all our target areas, and the associated better access to urban greenspace play a positive role in many of the narratives of belonging and sense of place evident in the interview data.

"I do not intend to leave, do not want. I think ... I raised my children here, the four were raised here, since they were born ... Here it is very quiet. I would get out of here if it was just for me to go to a quieter place yet. In the woods, someplace more remote. In the city, no way." (R5 NC)

The role of ES in place identity is even more pronounced in the more peripheral and less densely populated areas of Nova Contagem. When asked what he would show a visitor in his local area, the below Bougainville inhabitant responds:

"I would say [this is] a neighbourhood with lots of trees, a quiet neighbourhood, you feel at peace when you get there, you feel calm."

...

I would show to the person that the neighbourhood itself and its surroundings provide for a countryside lifestyle, a quieter life, farm life, as you're in a more wooded area, so to speak, which is a place for you to rest, here is a place for you to rest as it is a quiet place." (R4 NC)

The above quote is from an interview of a resident of Bougainville II, a part of Nova Contagem where the settlement is informal. The plot was sold to the respondent by an estate agent, and though the plot is registered at the Town Hall, the neighbourhood is not. This means that there is a poor level of service provision (no postal, sewage, drainage, telephone or internet). Therefore, it appears that ES provision can to some extent compensate for the manifestations of incomplete urbanisation and associated access to services in our data. The easy access to urban fringe vegetation in the irregular areas of Nova Contagem and the neighbourhood of Tupã, which is badly connected and described by residents as neglected by the authorities, forms an important positive characteristic of these neighbourhoods. To many residents the easy access to urban fringe vegetation (SPU1) and associated ES constitutes the unique attraction of Tupã.

“Those woods over there have a lot of plants that people know to be good for making medicine.”
(R11 T)

As suggested at the beginning of this section, both actively co-produced ES and EDS and the SPUs themselves are often framed according to what they are perceived to communicate collectively and to the interviewee about the residents and the local community more broadly. Like the urban streams discussed above, bare soil is an SPU that is perceived as prone to EDS provision. Although the ES assessment does not detect significant risk of landslides, unpaved roads and the plots where vegetation has been cleared are perceived as capable of increasing the risk of landslides and runoff that hampers traffic and causing risk to roads and water quality in the interviews. Risk of runoff and adverse water quality impacts are to some extent supported by the formal ES assessment. But in the interviews, the production of these EDS is specifically associated with new occupations. Unpaved roads on the other hand are widely taken as a sign of spontaneous invasions and symbolic of neglect by the authorities (Image 7).

“notice how the occupation is irregular, when it rains here, for example, there are many landslides, there is one that you can see from here, where part of the street collapsed and the bus stopped to pass up there.” (R25 NCW).

Interviews therefore evoke certain ES or EDS as a marker of differences – e.g. in the type of community living in the neighbourhood (Tables 4 and 5). Here in particular, the decisive contextual factor seen to contribute to the production of EDS is the lack of care expressed by residents:

“even the people who invaded [land for housing], have a sewage network. But when it gets blocked I think that they consider it is easier to discard it in the stream. You know, I don't think this is the administration's fault, I think the person him or herself is responsible for that...” (R30 NCW)

While EDS are perceived as abundant in areas of newly established informal occupations (housing type 3), well cared for urban squares in the congested central Nova Contagem mark responsible or a caring communities (see also Mee 2009). Remarkably, again, the provision of these is not seen as conditional on the municipality taking responsibility for maintenance (see also Image 8).

“[I]: There are even flowers in this one here, this square...”

[R]: There are, the people here take care of it, you know? But this is not a municipal administration service, you can be sure.

[I]: Then, these squares that are more beautiful are things from the community.

[R]: From the population itself.” (R25 NCW)

This below respondent suggests that the mere existence of greenspace would encourage a more responsible attitude among residents:

“[I]: do you think Nova Contagem needs more space for nature?”

[R]: Look, now, it did not, this question .. There's no park, something that encourages people to care more.” (R31 NCW)

Going even further, the below resident of Bougainville, the irregular neighbourhood where the planning status of many houses is ambivalent and access to services is very poor suggests that the presence of ES affords certain types of behaviour and discourages others. The easy access to abundant ES is highly valued and contributes positively to neighbourhood character, sense of community and even lower crime rates, according to the below resident:

"I think when people come here, they feel ... a different philosophy of life, because they see a calm environment, close to nature, for example, we have a green forest next to here, which is a preservation area ... I have not seen people playing loud music, people commenting about high levels of violence. For some time now, recently, this year, ... we're seeing increasing the issue of violence here. But until two, three years ago, that was the year I moved here, we did not hear about that. Not ever seen." (R4 NC)

To some, the abundance of green areas and the tranquil nature and way of life that this affords also suppresses anti-social behaviour and incentivises a more caring attitude to the neighbourhood among residents (see also Kraftl 2014). Again, although poor municipal service provision is key to the emergence of EDS, many respondents suggest that an even more important factor is people's attitudes and sense of responsibility – the impact of spontaneous occupations that are portrayed as reckless 'invasions' for example. As suggested above, several respondents associate lack of care with new residents that have or are in the course of moving to newly occupied informal housing. The construction of EDS seems therefore partly to hinge on moral codes of appropriate behaviour in relation to urban space. Moreover, the interview material shows that SPUs and the resultant scope for ES provision play a role in feelings of belonging, pride and local identity, but also in affording specific types of activity and behaviour (Kraftl 2014; Mortimer-Sandilands 2005). Urban greenspace therefore can increase residents' sense of agency in influencing their surroundings and suppressing undesirable behaviours that they find problematic. While for example Mortimer-Sandilands (2005) argues that park design signals and accommodates social behaviours that are perceived as acceptable in the mainstream and suppresses ones that depart from these, our interviews show that, in a disadvantaged context such as Nova Contagem target areas there are efforts to harness these affordances to benefit residents and consolidate the local community. And as for the role of housing status, the area with the highest number of formalised housing, central Nova Contagem, comes off as the least 'liveable' neighbourhood in this informal hierarchy. This suggests that public greenspace and private back gardens are not interchangeable in terms of experienced benefits despite often yielding similar indirect ES, and serve different purposes in terms of liveability and wellbeing. The decisive factor for the availability of public and indeed private greenspace is population density. But as the ES assessment suggests, the scope for greenery is not fully utilised in central Nova Contagem, where for example urban squares tend to be paved over.



Image 7.



Image 8.

Images 7 and 8: an unpaved 'neglected' road in Tupã and a well take care of square in central nova Contagem. (Source: interview respondents through the Urban App)

Overall, although there is an association in the interviews between the status and economic significance of a neighbourhood (often in terms of numbers of residents - taxpayers or voters) and the extent of public investment in services, it is not just these overt factors of incomplete urbanisation that are decisive for wellbeing, liveability and overall quality of life in the neighbourhoods. Urban greenspace is allocated multiple functions as a part of the urban fabric and yields significant material benefits especially in neighbourhoods where living density is low. Regardless of abundance, the signifying role of urban greenspace comes to the fore especially in neighbourhoods where perceptions of crime are high and informal occupations are seen to threaten the established quality of life. But while formal planning policies recognise the significant water provisioning ES of the target areas, these local needs and appropriations of the natural assets are overlooked. Nevertheless, our data also demonstrates that whatever the outcome of public plans, projects, and works, the residents' everyday uses and appropriations of the neighbourhoods, including its greenspaces, play a significant role in transforming these peripheral urban spaces into places, and that this collective transformation produces a sense of collective belonging and agency, and sometimes, potentially, political strength (Massey 2004).

4.4 Incomplete urbanisation and the contextual factors hindering, enabling and motivating the production of directly experienced ecosystem services

All our target areas with the exception of Solar do Madeira represent low income areas, which have their origins in displacement. In addition to low level of basic service provision, all target areas suffer from a lack of employment opportunities and high incidence of crime although this latter seems to be concentrated in the central Nova Contagem area. Despite its variable quality, interactions with greenspace such as urban fringe vegetation, urban squares, private gardens, stream riparian areas

and the reservoir contribute positively to the wellbeing of the residents in these predominantly poor neighbourhoods (see also Mitchell et al. 2015; Wright Wendel et al. 2012; WHO 2016). This wellbeing hinges not only on tangible benefits to lifestyles such as better scope for outdoor physical and social activity, more varied diet, access to medicinal plants and to extra income, but also a stronger and more positive place identity and associated feeling of belonging and agency. This resonates with what DeLanda (2016) terms territorialising functions benefitting the cohesion, agency and functioning of the neighbourhood from the point of view of the residents. These benefits and the ability that greenspace affords for residents to make distinctions in, and order and manage their neighbourhood environments plays a central role in the emergence of positive place identity and feelings of belonging despite the history of displacement.

But while symptoms of incomplete urbanisation motivate the co-production of ES, it also underpins the production of EDS. Social-technical factors (Andersson et al. 2015) such as lack of sufficient waste collection facilities and neglect of management of public spaces is seen to sanction EDS such as littering and anti-social uses of existing greenspace. Fear of crime (lack of adequate policing) is a significant factor hindering the use of squares and parks (Wright Wendel et al. 2012). Moreover, some uses of the SPUs, such as motor sports at the Vargem das Flores reservoir, decrease the scope for others such as peaceful walks and picnics. Although these limitations to some extent depend on individual preferences and perceived capability to engage (Fischer and Eastwood 2016), ultimately, they too can be traced back to the lack of adequate investment on the part of public authorities (such as the lack of supervision at the reservoir) and therefore, neglect.

Nevertheless, the level of care and responsibility demonstrated by fellow residents is also highlighted by our respondents as determining whether elements of urban nature become translated into beneficial services or dis-services. In a chaotic unmanaged context where residents experience varying levels of vulnerability in regard to their housing status and neglect, urban greenspace is engaged in the construction of moral codes of appropriate behaviour that represent residents' efforts to gain control over their circumstances. Littering and discarding sewage in urban streams demonstrates lack of appropriate care and understanding of the neighbourhood and the local environment where as well looked after urban squares attest to residents who care for their shared surroundings, have established and are likely to defend agreed norms and by extension, belong. Central Nova Contagem represents a typical poor urban neighbourhood where the limited ability and motivation of residents to access the poor quality public greenspace is compounded by high risk of crime (Wright Wendel et al. 2012). Here, the signifying function of 'cared for' urban squares and front gardens comes to the fore: for residents, this is an important way of communicating social norms and imposing order in otherwise chaotic context. This signifying function of urban greenspace may to some extent explain the correlation reported in literature between increased access to greenspace, community cohesion and lower crime rates (UN-HABITAT 2008) as well as the potential equalising impact of ES evidenced for example by Mitchell et al. (2015), who determined a correlation between improved mental health and access to greenspace among economically disadvantaged individuals in a global scale study. What is notable here is that the problems associated with incomplete urbanisation therefore also *motivate* the engagements with greenspace – the co-production of ES – for the purpose of what they are seen to *signify* (how they are constructed) in the specific context. The ongoing land occupation and the high incidence of crime create a need for residents to enforce a more positive neighbourhood image through specific

types of engagements with public greenspace. Where Anderson et al. (2015) suggest that local environmental problems such as low air quality emphasise the benefits of the air purification function of urban trees, similarly, here issues such as irregular housing status, crime and noisy and overcrowded conditions emphasise the function of urban squares and front gardens in representing behavioural norms and expectations of the local community.

Nevertheless, at present in our target areas at least, locally experienced ES and EDS are little if at all recognised in formal planning initiatives such as the ZIM designation and earlier environmental restrictions which focus on the metropolitan scale ES benefits originating in the area. Our findings suggest that this oversight of the local scale experienced ES has ultimately compromised the quality of ES provision overall. Neglecting the significance of urban streams in the everyday lives of residents for example has led to the proliferation of their use in waste disposal and increased the incidence of flooding and pollution. Moreover, the provision of urban greenspace has been all but neglected in central Nova Contagem where it is mostly limited to these polluted riparian areas and private back gardens. In line with the logic of incomplete urbanisation, the municipality of Contagem is proposing to sanction more development elsewhere too, to achieve higher housing density, and there is reason to believe that this has already incentivised speculative occupation of land for development. This does not bode well for local level ES provision in the more peripheral neighbourhoods. Our data indicates that valuable local level experienced ES are at high risk of being lost in the processes of urbanisation, whether formal or informal. Therefore, the articulation and integration of both local experienced and metropolitan scale indirect ES as equally legitimate in planning processes seems a pressing need not only in areas of informal housing where ES remain more prevalent but also in the densely populated central Nova Contagem. The liveability of central Nova Contagem could likely be significantly improved by recognising and protecting positive informal appropriations of greenspace and ES in municipal and metropolitan plan making processes and supporting and encouraging residents' efforts in engaging with urban greenspace to contribute to a more positive neighbourhood identity. Likewise, formal recognition and maintenance of the value of very local scale green features such as riparian areas and urban squares might support their valorisation more broadly among residents and address the cycle of neglect and production of EDS.

5. The potential for improving sustainability and maximising wellbeing through an ecosystem services based approach in planning

5.1 Need for context sensitive ecosystems services assessment

Our qualitative analysis of directly experienced ES and EDS highlights two things. Firstly, that context matters not just to whether urban greenspace is accessed and engaged with by urban residents but also how, and towards what ends this is done. Accessibility and extent and quality of greenspace influence experienced benefits and benefits decrease with housing density. But the socio-material context of urban neighbourhoods also conditions what greenspace is used for, such as waste disposal, foraging or informal leisure activities such as the Vargem das Flores reservoir. Moreover, 'culture' matters in a myriad of ways for ES, through a) extent and types of knowledge about ES possessed and prioritised by different individuals and groups; b) differences in identity, capability and perceived personal safety risks that influence engagements with nature subjectively and collectively; and c) different ways of interpreting and valuing both existing SPU and the engagements that people have with them (the co-production of ES itself).

Secondly, while the level of urban service provision is pivotal to both liveability and the realisation of ES, informal appropriations of urban greenspace are central to the quality of life and agency experienced by residents in our target areas. Experienced ES matter not just in terms of supporting varied diets and access to alternative medicine but urban squares, fringe vegetation and land cover type are engaged to influence and mark the perceived status of settlement at neighbourhood or street level and are seen to have a bearing on context specific safety issues.

Therefore, the relationship between wellbeing and ES can be described as reciprocal. ES benefit wellbeing but the freedoms, constraints and needs that people experience in their everyday lives also condition their interactions with the natural elements of their environments. To really assess ES delivery, we need to understand the needs and constraints that motivate engagement with SPUs. Our analysis demonstrates that urban SPUs are highly multifunctional, simultaneously providing large scale indirect and a range of local experienced ES and EDS. The complex ways in which SPUs and co-produced ES are integrated as signifying and material elements of the urban fabric hinge on the complex needs, motivations and capabilities of local residents and if the much lauded health and wellbeing benefits of urban ES are to be maximised, these insights are necessary to challenge and expand the limited uses conceived for urban greenspace in formal planning practices.

While engaging with the conventional MEA based ES approach in this paper, we have made a distinction between indirect, mainly scientifically detectable ES representing the categories of supporting, regulating and provisioning ES, and directly experienced services and dis-services that are mainly constituted by the conventional cultural ES category but also extend to provisioning and regulating ES. The directly experienced ES, either actively co-produced or passively co-constructed and assigned a meaning bear a resemblance to the context specific benefits that people derive from nature described in a recent paper by Dias et al. (2018). Of all the commentaries that have ensued form the critique that Dias's approach directed at the ES framing, we are most in agreement with that by Petersen et al. (2018) who suggest that ES scholarship and practice should remain open to the benefits of multiple framings of the nature-society relationship. Our findings from target areas that represent a context of incomplete urbanisation demonstrate that a full understanding of the ecological processes, socio-economic circumstances and the socio-cultural context as well as potential more subjective factors conditioning engagements with urban greenspace is necessary for the identification of a full range of services and benefits (and dis-benefits) that urban nature provides. This in turn is instrumental to delivering environmental justice. Our findings suggest that the quality of life in these remote but relatively green urbanisations is improved by residents engagements with urban nature in its various forms and what this represents to residents, and likely compares favourably to in inner city neighbourhoods of similar socio-economic status and deprivation. But if these benefits are not recognised in formal planning or conventional ES assessments they risk being lost to 'development processes' such as housing densification that is in our target areas perceived as a means to justifying better urban service delivery.

In terms of methodology for systematically understanding and assessing directly experienced ES, the SPUs that form the basis of the ES cascade approach (Spangenberg et al. 2014) present a unit of analysis that enables the integration of the more science based approaches to ES assessment with qualitative data on directly experienced ES. Our findings for example demonstrate that focussing just on the extent of green cover is not sufficient but distinctions need to be made between private back

gardens and public parks for instance as well as urban trees and areas of urban fringe woodland that enable foraging. However, the linear sequence from SPUs through utility value to benefit appropriation of the cascade model is less apt at capturing the co-production and co-construction of directly experienced ES and their contingency (see figures 2 and 5). A science led ES assessment can verify the potential for delivering supporting, regulating and provisioning services from existing ecological features, but the multitude of ways in which urban natural features are appropriated into the daily lives of residents and visitors needs to be understood through a context specific participatory assessment approach. The same applies to the needs and constraints that motivate and inform the co-construction and co-production of directly experienced ES.

From our findings it is clear that liveability variables play a role in both hindering and enabling engagements with urban greenspace. But further contextual variables relating to the collective needs and aspirations of the communities in question are also influential, particularly in motivating appropriations of urban greenspace. In our target areas the main contextual factors conditioning the co-production and interpretation of directly experienced ES can be listed as follows:

- 1) Active co-production of ES is hindered by low availability and quality of greenspace, overcrowding and lack of supervision. Often subjectively experienced fear of crime and possible persecution due to race or gender are all associated factors that hinder the benefits that certain groups are able to derive from urban ES (see also Wolch et al. 2014).
- 2) Both social-technical factors (Andersson et al. 2015) and normative perceptions of appropriate behaviour are at play when SPUs provide EDS. For example, lack of appropriate urban services and perceived neglect by authorities are seen to encourage rubbish dumping in streams and littering and antisocial behaviour. But what is interpreted as an EDS – unwanted or negative functions – often hinges on tacit moral codes and normative ideas regarding appropriate behaviour. Discourses of EDS production distinguish between ‘responsible residents’ that have a level of contextual knowledge of the area, show consideration to others and take appropriate care of their surroundings, and visitors, new ‘invaders’ or land agents who do not know or care what is appropriate in terms of waste disposal, evading risk of landslides or obstructing residents’ right to forage through clearing of vegetation and cordoning off land for development. Many EDS discourses are therefore discourses of belonging and legitimisation in a unstable context where housing status is insecure and neighbourhood status and security are under threat.
- 3) Finally, perceived threat of criminal and antisocial behaviours also motivates the engagement of SPUs in signifying functions marking streets and neighbourhoods where residents take due care and are by implication also less likely to tolerate antisocial behaviours. Abundant greenery, even unmanaged, can also symbolise a more peaceful neighbourhoods that is seen to discourage antisocial behaviour in a context where this is a prevalent threat.

In the assessment of ES and their potential to benefit urban communities therefore, focus should be on the quality of urban services, and the problems, risks and needs experienced by residents in their everyday lives in the neighbourhoods.

Our findings also emphasise that a focus on the large scale ES benefits in planning should recognise the way that ES link distant practices, actors and benefits. Large scale ES draw agency from local

scale interactions, as demonstrated by the urban streams in our target areas, where local level EDS arguably compromise the ES supporting metropolitan scale water provisioning. There is a need to maintain focus on the multiplicity of scalar relations that any SPU may yield at any one time. Our methodology involving two distinct epistemological approaches to ES, one based on the MEA (2005) classification and one engaging the idea of experienced ES and qualitative inquiry elicited a large amount of comparable quantitative and qualitative data. However, while the science led ES assessment is potentially replicable in a planning context, the qualitative methods remain cumbersome and the scale of data large. The UrbanApp elicited data in the form of photographs and short comments regarding the functions of SPUs in residents everyday lives and associated benefits and problems. This georeferenced data builds a cultural mapping of the target areas that could form a basis for further participatory planning initiatives such as focus group discussions regarding development needs and the role of greenspace in these. But the use of the Urban App was hampered by poor cellular network connectivity and this is something that needs to be considered in app design if apps are to be used for participatory approaches. Nevertheless, the accompanied app walks elicited recorded narratives that complemented the interview material and provided the participants an opportunity to observe and reflect on the environment in more detail (Lee and Ingold 2002). In our data, it was the walking narratives where respondents most reflected on the significance of the SPUs and their role in distinguishing housing status and neighbourhood character. Lee and Ingold (2002) also suggest that walking interviews allow the researcher to develop a better, shared, understanding of the field through shared experience with respondents. The usability of the Urban App requires some development, but such online and offline tools for co-produced cultural mapping could constitute an effective option for public participation in planning initiatives.

5.2 Scope for ecosystem services based participatory planning in our target areas

Our findings suggest that our target areas suffer from inadequate urban service delivery such as sewage networks, waste collection, public transport, education, postal services and adequate shops. An improvement of basic services and access is necessary to improve overall quality of life, water quality in the urban streams and the reservoir and the liveability of the neighbourhoods. But better service delivery is not important just in material terms but also because of what it signals to the local community about the value of their neighbourhoods. This allocates responsibility to the municipality, but the metropolitan planning process is also implicated. Zonal designations such as the ZIM that aim to protect large scale ES need to be better embedded in the local context and respond to local needs and appropriations of the SPUs that underpin large scale water provision functions for example. While municipal and metropolitan scale planning processes should deliver to a shared agenda that integrates metropolitan and local level needs, proactive local planning measures are needed at municipal level. Any ES assessment underpinning land use zoning should have as its focus the potential contextual factors that condition the co-production of ES and that motivate and provide focus for their co-construction and significance for local communities. Clearly, a more explicitly ES based approach to zoning in our target areas would be beneficial but any intervention needs to focus on what is needed to stabilise the desired positive ES that respond to both metropolitan and local level needs. For example, the range of local scale EDS provided by urban streams that threaten to compromise the metropolitan water provisioning function of the catchment suggests that managing ES provision to the benefit of both local and metropolitan scales requires conflict resolution initiatives, and possibly remuneration for maintenance practices that help minimize local EDS.

Presently, the two conflicting planning initiatives – the Metropolitan Plan and the Municipal Plan – propose different strategies for the valorisation of local assets. Whereas the new government of the municipality of Contagem wishes to add value, and returns for investment, to the area via increased housing density, the TVA approach proposed by the Metropolitan Plan aims to protect and valorise local natural features to the benefit of local economies and water provisioning (Eleuterio et al. 2015). Both plans therefore attempt to counter the processes of incomplete urbanisation via different means of commodification of local assets. More housing, as proposed by the municipality, would likely mean more investment and more and better basic services in our target areas, which would address some of the contextual factors underpinning nuisances such as rubbish dumping and possibly even address the situation with crime. But since formal planning presently overlooks the role of local level ES, there is a risk that development would result in loss of greenspace as it has done in central Nova Contagem, with few SPUs left in addition to private gardens. The anticipated relaxation of development controls proposed by the new local government is already a likely driver of the increased clearing of vegetation and fencing off of plots reported by respondents in the peripheral neighbourhoods of Nova Contagem. If on the other hand the Metropolitan Plan in its present form is passed by the State Assembly, the speculative land occupations might subside but there is no guarantee that the municipal government will increase investment in services in the area. Moreover, the micro scale benefits that our target communities garner from existing greenspace might be over looked in an agenda that is explicitly focussed on securing value for local economies.

Nevertheless, the TVA approach integrated in the Metropolitan Plan holds potential for an increased focus on the local level value of existing urban greenspace in the target areas. While the existing protective regulations in the catchment area remain inefficient, a pro-active management plan could help to align the ES supporting the water provisioning functions of the reservoir and local level experienced benefits. Particularly, at the Vargem das Flores reservoir, the TVA approach could offer a proactive planning instrument articulating a broader recognition of the role of ES in wellbeing and liveability and their integration into formal planning processes. It is not clear however, to what extent this could bear economic benefits for localities. But there is a rich tradition in participatory planning in Brazil, and the interviews provide some evidence of existing initiatives. Monte-Mor et al. (2016: 1142) describe LUMEs, Lugares de Urbanidade Metropolitana, an initiative that intends to engage community level and other non-governmental actors to contribute to the delivery of the goals of the Metropolitan Plan. Our interviews indicate that several residents are concerned about environmental degradation and behaviours that compromise water quality and broader quality of life in our target neighbourhoods, and a LUME might provide a platform for organising community action to address these. Moreover, this would help nurture the actions that residents are already undertaking by engaging ES to deter crime, express a sense of community and to compensate for the lack of service delivery, and that contribute directly and indirectly to their wellbeing and lend them further legitimacy. There is clearly scope for citizen led action, if support from the municipality, or perhaps from another planning actor such as Copasa is forthcoming.

This is not to say that all responsibility for operationalising the wellbeing potential of existing greenspace should be based at the local level and with voluntary and community organisations. The Metropolitan Agency needs to accept some responsibility for local level implications of its water sourcing. To fully mobilise the water provisioning potential of the relevant local level SPUs, the

agency that they yield to a myriad of alternative functions at the local level needs to be taken into consideration and engaged with. This could be through a networked governance configuration with the Metropolitan Agency, Copasa and the municipality of Contagem that would take responsibility for the recovery of riparian areas of urban streams for example, and the implementation of green corridors that also benefit the everyday lives of local residents. Payments for Ecosystem Services (PES) present one option for articulating and consolidating this scalar interdependence through metropolitan level funding for the maintenance of local riparian areas and better household sewage and waste management (e.g. Pagiola et al. 2013). The Itaipu 'Cultivating Good Water' initiative constitutes a good precedent for this (Itaipu Binacional 2015). The experiences from the Metropolitan plan process suggests that there is plenty of scope for such networked activity although the grassroots level has not yet been robustly integrated into the process.

To sum up, our main recommendation for planning in our target communities in the municipality of Contagem is to improve urban infrastructure and service provision. This will likely decrease a range of EDS associated with harmful environmental behaviour such as littering and ensure, that septic tanks and bypasses to the sewage network do not pollute the streams contributing to the Vargem das Flores reservoir. Alongside better service delivery, planning should identify and nurture both indirect water provisioning ES and those locally experienced ES that increase wellbeing and feelings of agency and belonging among all socio-economic groups. This could for example mean ensuring a minimum provision of urban greenspace and consolidation of so called everyman's rights to foraging and fishing in the urban fringe. Our data points to a range of specific measures that could be undertaken in the broader area of Nova Contagem, Tupã and the reservoir to discourage negative engagements with urban greenspace and the provision of ecosystem dis-services (EDS) such as the increased risk of water borne dengue. The articulation of experienced ES among the communities seems important, as some of them depend on local knowledge and awareness, such as foraging for edible a medicinal plant for example. Community groups could be set up and funded to safeguard positive uses of the available greenspace and advise residents' and planners regarding activities that compromise them. Open discussions about the value and function of some of the features such as the urban streams and their riparian areas, and the appropriate management of urban squares would also be of benefit. The local authority and other planning agents could play a role by supporting residents in initiating and consolidating activities that residents find beneficial, such as flowerbeds but perhaps also edible gardens and access routes in riparian areas.

What must be ensured is that the economic rationale, always ultimately measuring value in terms of economic returns, that underpins the phenomenon of incomplete urbanisation and is also manifest in the Municipal Plan's proposed densification of development is not allowed to dominate the TVA approach. Any articulation of ES benefits but particularly those directly experienced by communities need to be expressed in terms of a wide range of returns, not only economic, but also social, cultural, communal, educational and so on. At present the TVA approach is well poised to accommodate this. More explicit linking to broader sustainable development programmes such as the UN sustainable development goals or the Latin American wellbeing agenda exemplified by the Ecuadorean 'Índice de Vida Saludable y Bien Vivida' (IVSBV) could provide suitable alternative indices marking progress towards environmentally sustainable and just planning and development (Burchardt 2019). A perpetual search for economic returns for investment will continue to subvert the needs and interests of communities living in peripheral and informal areas.

6. Conclusions

In disadvantaged peripheral urban areas like Nova Contagem, the aspiration to advance the right to the city through the recognition and formalisation of informal land acquisition and housing development is tempered by what can be termed incomplete urbanisation, serving to perpetuate socio-economic and environmental disadvantage (Costa and Costa 2005). Our analysis of residents' engagements with urban nature and the processes through which they create and assign meaning to the natural features of their everyday neighbourhoods nevertheless show that urban greenspace can yield benefits that improve wellbeing and liveability even in such challenging urban contexts. But this relationship between ES and wellbeing is reciprocal. A deprived context where people's capacity to interact with greenspace is conditioned by insecure access and housing rights, risk of crime, poor urban service delivery and environmental degradation hinders some and creates other context specific needs and motives for engagements with urban nature. In such challenging contexts, through the practices of their daily lives, residents strive to create meaningful places and neighbourhoods where feelings of belonging and wellbeing can thrive. Central to belonging to a place is the notion of care and responsibility (Massey 2004; Mee 2009), and the ability to interact with and wield some degree of control over these interactions (van Dorst 2012). Urban nature, greenspace and water features, is a medium for this agency.

Our analysis of experienced ES has shown that in the peripheral disadvantaged context of our target areas, walking and picnicking, foraging for medicinal and edible plants and fishing are highly valued opportunities to interact with the local environment and play a significant role in quality of life, general wellbeing, social cohesion and neighbourhood character. In many cases, urban greenspace is engaged with to shape the look and character of the local neighbourhood, to mark distinctions in the informal status and character of dwellings, streets and neighbourhoods, to subvert undesirable behaviours, and to consolidate a positive place identity. These interactions can be seen as serving what DeLanda (2016) terms a territorialising function, where urban nature is deliberately recruited to support community cohesion and a positive place identity. But in the context of incomplete urbanisation, urban greenspace also affords dis-benefits. Riparian areas used for fly tipping and parks and trees that invite criminal activity can also serve a detrimental de-territorialising function and certain features and management practices are seen to mark illegitimate dwellings and behaviours (DeLanda 2016). These diverse interpretations of the functions, services and dis-services provided by urban greenspace highlight the role of what many writers term 'culture' in mediating our relationship with nature and the benefits that we accrue from it (Dias et al. 2018). ES provision is therefore the outcome of fundamentally socio-material interactions (Latour 2004; Murdoch 2001). It is clear that when it comes to urban ES, the MEA (2005) classification of ES is insufficient to capture the full range of the hybrid interactions that underpin urban ES.

The contribution of this paper is intended to complement and expand the ES based approach to urban environmental quality by developing the notion of directly experienced ES and highlighting the necessary epistemological rupture with the predominantly ecological, expert led ES approaches recognised to date. The ontology of co-production and co-construction provides analytical access to the complexity brought to human-nature interactions by human perception and subjective and collective processes of interpretation that are contingent on specific social and material contexts (see also Fischer and Eastwood 2016; Barnaud and Antona 2014). It is important to capture these in

ES assessments and planning and policy that aims to engage with urban greenspace for the benefit of all urban residents.

As for the drivers of incomplete urbanisation and the right of all residents to a minimum level of urban services and space, the overarching attention on economic value from investment remains problematic. The local level experienced ES benefits remain unaccounted for in this rationale and therefore unarticulated in planning processes. Lefebvre's (1996; 2001) much lauded right to the city is often misinterpreted as a narrow agenda, focusing on the right to access and items lacking in areas of incomplete urbanization – infrastructure, services and commerce. But a broader understanding of the right to the city in Lefebvrian terms includes the right to benefit from all urbanity including the accumulated knowledge and heritage of urban life, the right to culture and leisure, the right to power, to urban decision-making and politics, to every realm of urban life including its greenspace and nature. The agency that the freedom to appropriate urban greenspace for local benefit yields to the residents of the studied informal settlements remains precarious and threatened by both formal and informal development. Local level experienced ES need to be articulated in the processes of planning and environmental governance to ensure that the impetus for densification to justify expenditure on service delivery does not in fact compromise the liveability of peripheral, informal urban neighbourhoods. This requires broader indices of development than just economic ones.

In terms of a contribution to the notion of ES, we conclude that the relationship between ES and wellbeing is not one way but reciprocal – Inhabitants of our target areas are disadvantaged in terms of income, mobility, access to housing and employment and basic services such as waste and sewage management and policing, and the resultant feelings of insecurity and lack of agency clearly condition and motivate the engagements with urban greenspace in their localities. More precisely, this contingency on material, social and subjective factors shapes the production and interpretation of ES through enabling, hindering and providing motivation. Crucially, formal planning practices and environmental designations and initiatives such as the TVA approach in our target areas need to acknowledge these informal and contingent appropriations of urban nature at the neighbourhood scale, protect and nurture them to maintain their contribution to the wellbeing of residents and facilitate mutual benefits from ES delivery at a range of planning scales. The rich local level ES and EDS need to be acknowledged and taken into consideration in attempts to secure larger scale ES such the metropolitan water provision function of the Vargem das Flores reservoir. This recognition of the informal lived reality as a valid representation is central to advancing any notion of the right to the city in practice.

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